Telephone Engineer

WITH WHICH IS CONSOLIDATED THE WESTERN TELEPHONE JOURNAL
ESTABLISHED 1902

VOL. XIII — CHICAGO, APRIL, 1915 — NO. 4

PUBLISHED MONTHLY BY THE
ELECTRICITY MAGAZINE CORPORATION
Monadnock Building, Chicago.

Ed J. Mock and Paul H. Woodruff, Editors.
FRED B. SCHAFER, ASSOCIATE EDITOR.
TELEPHONES: HARRISON 3014-3015.

NEW YORK OFFICE.....1022 Longacre Bldg., 42d Street and Broadway
LONDON OFFICE.....36 Maiden Lane, Covent Garden
S. RENTELL & Co., Representatives.

Entered as second-class matter May 26, 1909, at the postoffice at Chicago, Illinois, under Act of March 3, 1879.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico.....Per year, $2.00
Canada.....Per year, 2.50
Foreign countries within the Postal Union.....Per year, 3.00
Single Copy..... .20

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach the office of publication not less than ten days in advance of date of issue. Regular date of issue, the first day of each month. New advertisements will be accepted up to within five days of date of issue, but proof of such advertisements can not be shown in advance of publication.

NOTICE TO SUBSCRIBERS.

REMITTANCES.—Remittances should be made by check, New York draft or money order, in favor of TELEPHONE ENGINEER. Foreign subscriptions may be remitted direct by International Postal Money Order, or sent to our London office.

CHANGE OF ADDRESS.—The old address should be given as well as the new, and notice should be received two weeks in advance of the desired change.

CLUB RATE.—In acknowledgment of assistance rendered by subscribers in the securing of new orders, a club rate of $1.75 per annum is quoted. This rate applies to new subscriptions in clubs of two or more.

This publication is free and independent of all business or house connections or control. No telephone company, manufacturer or supply dealer, or their stockholders or representatives have any financial interest in TELEPHONE ENGINEER *or any voice in its management or policy.*

CHICAGO, APRIL, 1915

TABLE OF CONTENTS.

Editorial 143-145
Permitted Discrimination.....143-144
The Attitude Toward Regulation.....144-145
Why American Service Is Best..... 145
Stories in Pictures.....146-147
New York Company Agrees to Reduce Rates..... 148
Chicago Urged to Take Over Automatic System..... 148
A. T. & T. Company's Annual Report.....149-152
Eastern Pennsylvania Independents to Convene..... 152
Commerce Report Shows Increase..... 152
Telephone Talks. By G. W. Cummings and Arthur Kneisel.....153-157
Iowa Independents Hold Nineteenth Convention..... 158
First Meeting of Standardization Committee..... 158
Applications of Theory to Telephony. By Prof. George D. Shepardson 159-162
May Tax Advance Rentals..... 162
Little Stories of Operating Activities.....163-166
European Telephone Development.....167-172
Physical Connection. By Hon. Frank Winters.....173-176
Syracuse May Get Minimum Rates..... 176
Michigan Third in Telephone Messages..... 176
Ohio State Shows Six Per Cent Surplus..... 176
Power Circuit Interference With Telephone Lines. By S. C. Bartholomew 177-182
Recent Telephone Patents. By David S. Hulfish.....183-185
Guide for Preparing Technical Papers..... 185
Toll Rates to the Coast..... 185
Public Utility Commission News.....186-189
Of Interest to the Trade.....190-191
Brevities of the Business..... 192

PERMITTED DISCRIMINATION.

RATE discrimination, in telephone nomenclature, means charging different subscribers different rates for substantially the same service. That is its simplest definition. The practice is capable of many ingenious variations at the hands of a clever manager. Its earliest application was during the mad scramble for subscribers which resulted in the rule "Get the rate if you can; but get the subscriber anyway." In the ordinary course of good business procedure the practice might have died of its own evil disposition. But competition with its new stress and strain, its seeming demand for extraordinary and desperate measures, developed discrimination from a casual dereliction to a customary and ever-present condition. Under constant pressure the published rate came to mean merely the maximum, etc., from which favored or specially aggressive subscribers were scaled down through all possible rate strata to zero. No authentic information has come to hand of an operating company actually paying a subscriber to take its service.

There can be no argument as to the evils of rate discrimination. Not only does its practice, undertaken in the heat of competititive warfare, sooner or later impoverish the operating company, but it utterly ruins the public disposition to pay equitable and level rates. And the company most injured is the one whose regular rates have been most nearly honest and equitable and so have not created for it an extraordinary fund for illegitimate use.

It is safe to say that rate discrimination as it is ordinarily known—that is, as a community affair—is almost obsolete except where competition exists. And in those places the state regulatory bodies—which are rapidly sweeping across the country—are successfully and quickly eliminating it by insisting on level and reasonable rates. This editorial, therefore, is intended to deal with a form of discrimination more subtle, more evil and more widespread in its effects than community discrimination ever was.

We think we can, without offending organized labor, use one of its principles as an illustration. When, in the interests of a better wage or better treatment, a strike is called in a certain industry, those organized workers allied with other industries, who continue to earn their regular wages, are called upon to contribute to the support of the striking contingent. This practice enables the strikers to carry on their campaign against the local condition that displeases them, even though their income is reduced to a deficit.

It is quite obvious that the same methods may be applied to public utility operation where a suffi-

ciently broad organization exists. For example, suppose the Jonesville Telephone Company and the Smithburg Telephone Company are owned by the same interests. They are both enjoying excellent rates, giving them, we will say, more than a "reasonable return." The people of Jonesville, having tired of this arrangement and being persuaded that just as good service may be had at a lower rate, have encouraged and developed a competing company. The Jonesville Telephone Company, scenting danger, thereupon cuts its rates below those of the competing company—indeed, below the point of profit. Then it is a campaign to see who can afford to lose the most money—the old company or the new. So far as local capital goes they may be equal or even with the advantage to the new company. But the Smithburg Telephone Company, in the background, still is "earning" its excellent rate; and if it be bold enough it may even arbitrarly raise that rate. Then it simply diverts a portion of its earnings to the support of the Jonesville Company and to cover the latter's deficit; and if the same interests operate also the Brownstown Telephone Company and the Greensburg Telephone Company and a half dozen others, so much more may be applied to support the "strike fund" of the Jonesville Telephone Company. In the end the competing Jonesville operator is broken and routed—and then the Jonesville rates are raised again, higher than ever.

Where efficient state commission regulation exists it is not possible to inaugurate a campaign of the kind described. But it is entirely possible, and quite practicable, to modify the scheme so that it operates very satisfactorily right under the noses of the commissioners. In a big telephone system, operating in many towns, any one branch of the system may be allowed to lose money indefinitely at the expense of the other branches, for the purpose of discouraging local competition and breaking an existing competitor. The rates at the competitive point may be obviously too low; but so long as they are uniform the state commission will not interfere. For the public, which is benefited, naturally will not protest, and if the harrassed competitor protests that his rates are too low for profit he is told that "your rival's rates are still lower, and he seems to be satisfied"; while if he claims that rival to be losing money wilfully he is regarded as mildly insane and laughed at.

With so much really efficient regulation being practiced daily by the commissioners, it is rather remarkable that so palpable a scheme should be permitted to go on unrebuked. No doubt the formal nature of commission practice, which demands that all complaints be wholly explanatory and obvious to the non-technical mind, has something to do with the neglect.

So we take this occasion to impress upon the honorable commissioners of public utilities in all states that a vicious type of rate discrimination exists of which most of them have not yet taken cognizance; that by its very nature it will not be brought to their attention through the usual channels; that the only possible protestant against it, the competing company, cannot present any proof that his rival is losing money; and that therefore it is just as important to insist that rates are adequate as that they are moderate.

This form of discrimination is being widely practiced today; and it the most important of all the rate-leveling problems before the commissioners because it is the only one against which a satisfactory protest cannot be entered without much information (most of which is unavailable to the complainant) and because of its subtle and insidious nature, which saps the life of competition at a high cost and makes the people of other communities pay the bill. It is a matter which every telephone association, state and national, should investigate and lay before the regulating bodies with all possible information.

THE ATTITUDE TOWARD REGULATION.

THE state of Iowa is just now interesting itself in the commission regulation of telephone companies. The newspapers of the state accordingly are arguing the merits of the question pro and con, with the usual newspaper disregard for what has been said and published before on the subject by others who have had actual observation and experience to guide them.

The *Sioux City Tribune*, in support of its contention that all commissions are pro-corporation and anti-public in their friendships, makes the following attack on the Wisconsin Railroad Commission, the most noted of all similar regulating bodies:

> Down to the last printed reports of that commission it had heard 134 petitions affecting public utilities of various kinds. Wisconsin municipal corporations or citizens of various communities had petitioned for reductions in public utility rates in thirty-nine cases. They were granted a substantial reduction in only three of the cases and were given nominal reductions in eight other cases. Municipal corporations or citizens had petitioned for better service from public utilities in thirty-two cases, and were granted the petition in twenty cases, but with the provision that in event improved service were given it should be accompanied by an advance in rates. Municipal corporations or citizens had asked for relief in ten cases from various unsatisfactory conditions imposed by public utilities and were granted relief in five of them.
>
> On the other hand, public service corporations asked permission to raise rates in fifty-two cases and were given permission in every instance. They asked for relief from conditions imposed upon them by the public, through councils, county commissioners or other bodies, in ten cases, and were granted their request in nine of them.
>
> To sum up the work of the Wisconsin Public Service Commission up to and including its last public report it had given the public of Wisconsin substantial relief in only 7 per cent of their cases and nominal relief in only 39 per cent of their cases. On the other hand, it gave the public service corporations substantial relief in 82 per cent of their cases and relief of some kind in 96 per cent of their cases.
>
> Because of this, the rates of public utilities in Wisconsin have been going constantly upward, the expenses of local government have been steadily increasing and the people of Wisconsin are revolting against the public utility commission idea. There are one or two more interesting chapters on how public service commissioners are proving the valuable ally of public service corporations and are licensing them to do as they please, over the protest of and against the best interests of local communities.

It is curious how prone to jump at conclusions newspaper writers are, especially where they are unhampered by any knowledge of their subject. It need scarcely be explained here that telephone utilities petition for higher rates because they are sorely in need of them—a condition disclosed in surprising extent by practically all investigating commissions. If the commission rulings seem to favor the corporations rather than the public, it must be remembered that the operating company dares appeal for help only when it has all its evidence in its hands; whereas the lay public appeals on its own beliefs and theories, often without a

shred of evidence to uphold its contentions. In short, the company generally has a case and the public generally has none.

The Wisconsin commission needs none of our support; but possibly all commissions need press agents, who could explain in words of one syllable for the benefit of newspapers and laymen in general, some of the simpler principles and functions of regulation.

WHY AMERICAN SERVICE IS BEST.

IN comparing public service utilities of Europe with those in this country, we soon reach the conclusion that those furnished here are superior and afford their patrons better service than those in Europe. The reason for this is that in the old countries these utilities being mostly owned and operated either by government or municipalities, there is no way to force them to make improvements, either in equipment or service. The equipment especially is used as long as possible, the policy being to get the most out of everything before making renewals, which, of course, is a good practice from an economical standpoint, but would not be satisfactory to American patrons.

America is far ahead of Europe in telephone service. Their equipment as a rule is inferior to ours. Although they have some very late and up-to-date appliances, the latter are confined to the most important centers only and are not pushed with the vigor characteristic to Americans, and are not considered at all in rural communities. Here again, government and municipal ownership makes itself apparent. New lines and circuits are not constructed, unless it can be shown beyond a doubt that it will be a paying investment, or until the old ones are absolutely worn out. Applications for telephones in some of the principal cities, including Berlin and London, have been on file for over a year, in thickly settled districts, but were not supplied because there were not enough in that particular vicinity to make the lines a paying proposition from the start and no effort was made to increase the list.

This is also true of equipment, which is kept in service as long as it can possibly be made to work. At the same time it is kept in as good a working condition as its character will admit. John Schmidt can not demand a new telephone simply because August Schmidt had a new one yesterday. He must continue to use what he had until it is absolutely worn out.

Some of our western towns and sparsely settled states, regarded by our European friends as practically only a wilderness, have better telephone facilities than many of the larger cities and commercial centers in Europe; while in the medium sized cities and smaller towns, although considerably larger when compared with similar towns in our country, telephone equipment and service is mostly antiquated, and are not used extensively by the common people. The service is still regarded as a luxury to be indulged in by the better class of people only; while business men in the progressive part of Europe are only now learning to regard telephones as a necessity. A superintendent of construction in Berlin had no telephone in his house, while he had several in use in his office, and his wife stated that she had never used one.

The conditions in Italy at present are somewhat like they were in this country twenty years ago. Appliances are rather primitive and service poor, as viewed from our standpoint; but they are beginning to look for improvements and are keeping fairly good tab on American progress. Construction is simple but poles seem to be in good condition, being treated with preservatives. Cross arms are invariably of iron and are short, containing only six or eight pins. Insulators are porcelain and there are fewer cable leads. This is true of the larger cities, such as Genoa, Naples and even Rome and other large centers.

The conditions in Greece are not any better, if as good, while in Turkey most people look upon telephones with suspicion. The most enterprising merchants of Constantinople, with branch houses in nearly all of the largest cities in Europe and America, have no telephone at home. This condition, however, improves as one travels northward toward Buda Pest, Vienna and Berlin. In the latter city construction and equipment are quite up-to-date. There are some good common battery plants, and older and inferior type of equipment is relegated to smaller places. In the larger cities a great deal of underground work is being constructed, which is quite difficult at times.

But what of the rates? They are generally said to be much lower than in this country, but this statement does not hold good when one considers all the charges made in connection with the telephone service, but we must give the Europeans credit for having evolved a more adequate and a more equal basis for rates than what is in vogue in the United States. In most places an installation and maintenance fee is charged, which is based upon the distance the subscriber lives from the central office or center of distribution and is practically about one-half of what is charged here for unlimited service. In addition to this, each call is paid for at a stipulated price, hence those who use the telephone most pay larger bills than those who use it less, which is the correct principle.

There seems to be only one redeeming feature in government and municipal ownership as practiced in Europe, and that is, the employes are not accountable to nor are under the control of the ordinary ward politician and the permanency of their jobs depends upon efficiency and faithfulness only; consequently it is not so much of a nuisance as it would be under the system of coercion and graft practiced in some American cities.

Their method of collecting bills is very good. Service is generally contracted for and payable in advance, except measured service. All bills are payable not later than the fifth of each month, at a certain place or office. The government or municipality does very little collecting, but the subscriber pays. If bills are not paid by the close of business hours on the fifth, service is discontinued immediately and is not re-established until all bills are paid in full, together with a fee for disconnecting and re-establishing the service.

Subscribers are required to contract for a year and must give three months' notice if the service is not wanted at the expiration of that time; otherwise must pay for an additional three months.

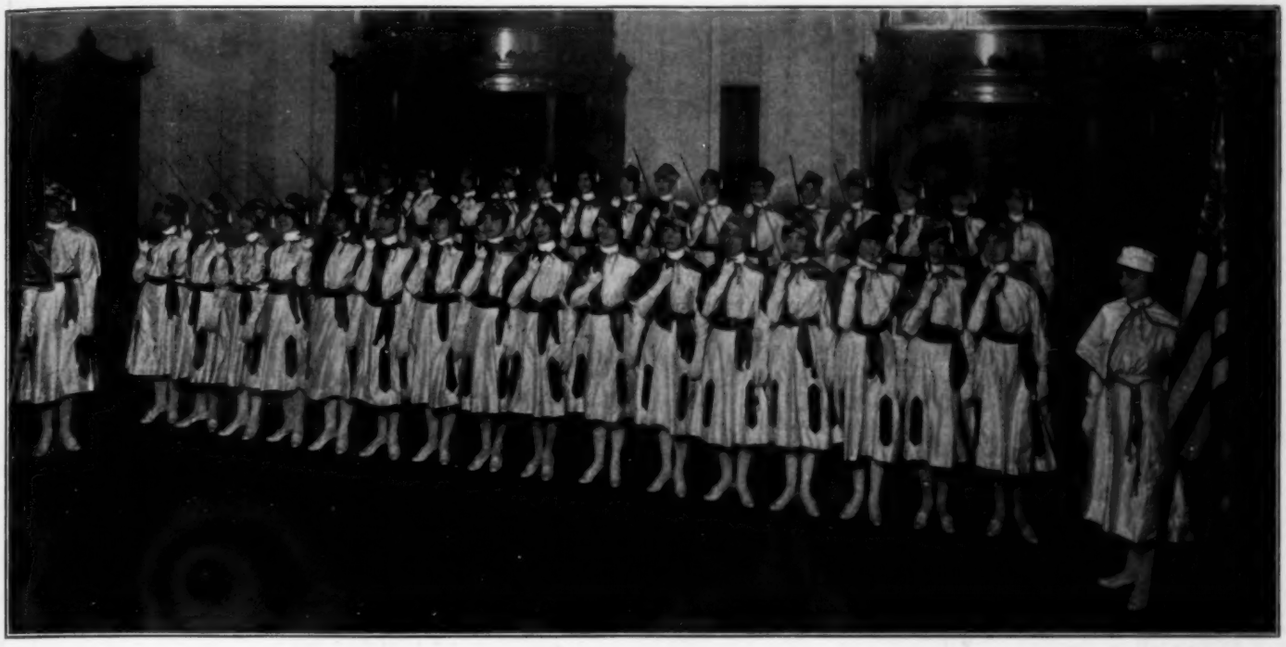
If changes in location are desired, at least thirty days' notice must be given and the subscriber pays for all the expense incurred in making the change. If the old line is not used by someone else the subscriber must pay an additional installation charge.

If rules are violated service is discontinued, but no money refunded. Every subscriber is held responsible for the abuse of his telephone privileges by others, as well as for damage to lines or theft and damage to equipment on his premises.

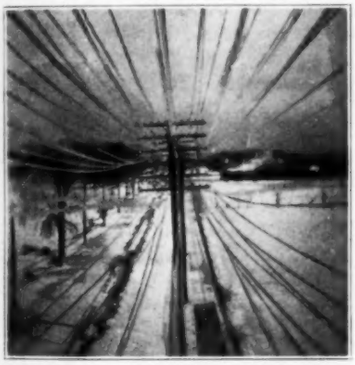
All in all, if the rules and regulations prevalent in Europe were adopted in this country subscribers would think them very arbitrary.

MILWAUKEE - MARINETTE TOLL LINE #12
POLE #304 - LOOKING WEST TOWARDS RONDA AND SEVEN MILE HOUSE. FEB. 3, 1915
MILWAUKEE - MARINETTE TOLL LINE #14
AT POLE #138 LOOKING WEST SHOWING
MILWAUKEE - MARINETTE TOLL LINE #10
AT POLE #148 LOOKING WEST. FEB. 3, 1915.
MILWAUKEE - MARINETTE TOLL LINE #16
AT POLE #201 LOOKING WEST FEB 3, 1915.
MILWAUKEE - JANESVILLE TOLL LINE #9
AT POLE #218 - LOOKING SOUTH - SHOWING LINE BURIED IN CENTRAL OF ROAD
MILWAUKEE - JANESVILLE TOLL LINE #8
POLE #271 - LOOKING SOUTH - SHOWING POLE ON GROUND & OTHER POLES & WIRES BURIED
FEB. 2, 1915
MILWAUKEE - MARINETTE TOLL LINE #8
AT POLE #164 LOOKING WEST SHOWING POLES STANDING
WITH TREE PROTECTION. FEB. 3, 1915
MILWAUKEE - MARINETTE TOLL LINE #5
AT POLE #140 LOOKING WEST - STORM BLOWN POLE.
FEB. 3, 1915.
MILWAUKEE - MARINETTE TOLL LINE #5
AT POLE #189 LOOKING WEST SHOWS TWO EMERGENCY CIRCUITS FEB 3, 1915
MILWAUKEE - MADISON TOLL LINE (OLD) #11
POLE #699 - LOOKING SOUTHEAST - CABLE TERMINAL POLE NORTH OF R.R. TRACKS
AT PEWAUKEE - FEB. 4, 1915.
MILWAUKEE - JANESVILLE TOLL LINE #3
MEN REMOVING WIRE FROM ROAD NEAR POLE #276 - LOOKING SOUTH - FEB. 2, 1915.
MILWAUKEE - MADISON TOLL LINE (OLD) #10
POLE #695 - LOOKING NORTH - TOLL & LOCAL CABLE TERMINAL - POLE NORTH OF R.R.
TRACKS AT PEWAUKEE - FEB. 4, 1915.

Views of Storm Damage to Pole Lines of the Wisconsin Telephone Company and American Telephone and Telegraph Company in Wisconsin, February 15. Captions on the Pictures Give Some of the Details. In a Few Cases the Poles and Lines Were Absolutely Destroyed.—Photos by Courtesy of the Bell Telephone News.



"Present Arms!" Members of the Telephone Drill Team at the Big Triple Alliance Minstrel Show Given for Charity at the Auditorium Hotel, Chicago, February 9 to 12, by the Amateur Talent of the Chicago Telephone Company, the Commonwealth Edison Company and the People's Gas Light and Coke Company. Four Night Performances and a Matinee Were Given, and the Affair Was a Great Success, Nearly $23,000 Being Handed Over to Charitable Organizations. The Girls Shown Are, of Course, Telephone Operators.—Bell Telephone News.



Sleet on the Toll Wires of the Michigan State Telephone Company on Oakland Avenue, Detroit, February 1.

Barnacles on a Temporary Hand-Made Submarine Cable Across the Miles River in Maryland. It was Laid Two Years Ago by the Farmers' and Merchants' Telephone Company, and Is Now Raised to Be Replaced by the Chesapeake and Potomac Telephone Company.—Courtesy of the Transmitter, Baltimore.

Another View of Total Destruction by Storm in Wisconsin. The Black Spots in the Center Are All That Was Left of an Important Toll Line.

"Bent But Not Broken." Detroit-Redford-Pontiac Lead Two Miles North of Redford, Mich. Michigan State Telephone Company.

Views of Storm Damage to Pole Lines of the Wisconsin Telephone Company and American Telephone and Telegraph Company. Some of the Details. In a Few Cases the Poles and Lines Were Absolutely Destroyed.—Photos by Courtesy of the Bell Telephone News.

New York Company Agrees to Reduce Rates

The New York Telephone Company has declared before the meeting of the Public Service Commission that it was prepared to present a reduced schedule of rates $3,000,000 if a valuation of $84,000,000 was fixed upon the plant and if the rate of return upon the valuation should be fixed at eight per cent.

The proposal put in by the telephone company provides for a cut about five per cent less than that recommended by the Foley committee. The reduction in receipts now proposed by the company added to the ten per cent cut that it made some time ago would total $4,900,000 a year. It is expected that the commission will order a reduction of $5,000,000, the new rates to go into effect on July 1 and to remain unchanged for a period of three years, or two years less than the period suggested by the company.

The valuation was a compromise between the valuation of $65,000,000 set by the committee and the value fixed by the company. A reasonable period would be asked for before the change would go into effect, probably six months, so that necessary changes could be made. It would also be insisted upon that if the order is accepted there be a guarantee of no further investigation by the commission for a period of at least five years.

It was explained that the increase in the valuation of $84,000,000 or $2,000,000 more than was fixed on June 1, was due to changes made when a voluntary reduction in rates was put through by the company.

The proposed new schedule provides for an abolishment of tolls between zones 1, 2, 4 and 5, comprising Manhattan, the lower Bronx, and Brooklyn, so that a call can be made from Coney Island to Tremont section for the local charge of five cents.

The company states that, considering all the elements of the situation, it will be impossible to make a harmonious schedule of rates which will cut out a fixed and arbitrary amount. It declares that the company's attitude is one of conciliation, and will go far to avoid the possibility of litigation. The answer then says:

If the following points can be agreed upon then the company is prepared at once to present a schedule of rates:

First, that the value of the property be fixed at $84,000,000 for rate making prices.

Second, that the rate of return upon valuation be 8 per cent.

Third, that a reasonable period before the new rates, if adopted, take effect be allowed in order that the additional plant required may be installed. Six months is suggested.

Fourth, that the final order, if one is entered, provide that the new rate remain in force without change for a reasonable period to avoid uncertainty and disturbance. Five years is suggested.

In its preliminary report the company says:

In the very complex and difficult situation which now exists as to the New York city telephone rates, the company's attitude is one of conciliation. It is willing to go far to avoid the possibility of litigation, which would necessarily be extremely annoying and expensive to all concerned.

In order to bring about an economical and satisfactory adjustment and to retain and strengthen, if possible, the good will it now enjoys, the company will consent to a revision of the rates.

Chicago Urged to Take Over Automatic System

Recommending that the city of Chicago take over the entire system of the Illinois Telephone and Telegraph Company, known as the Automatic Company, Commissioner of Public Service Montague Ferry has completed a report for presentation to the city council.

Further recommendation is made that Chicago lease the entire system to a company on condition that the leasing company show proper financial responsibility. The report also provides that the leasing company shall assume the bonded indebtedness outstanding against the system, and the additional condition that the company build, operate and maintain sufficient number of interconnecting or semi-automatic exchanges to accommodate interchange service between the automatic system and that of the Chicago Telephone Company.

The report goes into every phase of the telephone situation in Chicago, data having been gathered by investigators in various cities of the country.

Throughout the report the commissioner of public works and his associates lay stress on the feasibility of interchange service, which they maintain will solve the telephone situation in Chicago to the satisfaction of everybody concerned. The contentions of the Chicago Telephone Company that interchange service is not feasible is attacked, and affidavits are attached to the report showing that such service is successful in Louisville, Ky., Aurora, Ill., and other cities.

The cost of the telephone system new, according to the report, was estimated by the company at $4,900,090.77, to which may be added $244,273.49 for shop and storeroom material. The estimate of the city electrician; for the same date, August 1, 1913, was $3,998,915.82, no estimate of shop and store materials being made. The city's estimate of present value is $3,608,030.35. The Chicago Tunnel Company listed intangible values made up of losses in operation, expenses of changing and reinstalling substation equipment, soliciting and advertising, with additions for overhead cost totaling $1,092,632.25, which, added to tangible values as estimated by the company, make a grand total of $6,236,996.61.

The report says that the immediate value of the tangible property of the Chicago Tunnel Company is estimated at $1,177,100. Also that if the plant is purchased by the Chicago Telephone Company at the suggested price, there is then a loss of something more than $4,500,000.

The report offers no objection to the Chicago Telephone Company leasing the automatic system from the city after the city has taken over the plant, providing the Chicago Telephone Company will agree to the interchange service.

Minnesota Telephone Companies' Growth Rapid

Remarkable growth of the telephone business in Minnesota is shown by reports filed in the office of State Treasurer. Eight years ago there were 168 telephone companies in the state, reporting gross earnings on which the state collected $85,000. In 1914 there were 1,200 companies and their gross earnings entitle the state to a tax of $250,000.

The Northern Chemical Engineering Laboratories at Madison, Wis., announces the adoption of the shorter name, "C. F. Burgess Laboratories." The new name implies no change of management, ownership or practice.

A. T. & T. Company's Annual Report

A Brief Resume of the Bell System's Record for 1914

AS an index of business conditions in the United States, this year's report of the American Telephone and Telegraph Company has unusual interest.

Without progress there can be no prosperity, is the way President Theodore N. Vail sums up the situation. Telephone business has not suffered as much as other industries, but the growth of the Bell System has been retarded. Therefore Mr. Vail goes back to first causes and in a letter accompanying his report gives a searching analysis of economic conditions, which have put two million people out of employment.

Furthermore, he points out the relief needed by general business in order that the bread line may become a working line night and morning between places of employment and homes. To roughly epitomize his conclusions is all that is possible.

Never were the basic conditions of the country better than now for a restoration and continuance of normal conditions. The correction is simple and is pointed out by numerous precedents of the past and by well established economic laws. The extension and improvement of our transportation facilities is necessary to meet the increasing demands of the country both as a "going" and a "growing" concern. A billion dollars a year are needed and there must be a restoration of confidence which will enable the companies to procure at least a part of this necessary capital. That would mean employment and the circle of industrial conditions. For employment means ability to purchase. Ability to purchase means consumption. Consumption means production, and production for which there is a demand means prosperity.

AN EPOCHAL YEAR.

The opening of the transcontinental telephone line, bringing San Francisco within commercial talking distance of the principal cities on the Atlantic seaboard, gives particular interest to the engineering features of the year's report.

Few can appreciate the years of indefatigable labor on the part of our entire staff and the immense sums of money which this achievement has cost, and fewer still can foresee the countless ways in which it will, from now on, make for the benefit of all the service rendered to the public everywhere. In the Bell system standardization does not mean standing still but means increasing effort, continually improving and upbuilding. The plant is like a living organism, always growing larger and being renewed bit by bit as it grows. Under the intelligent direction of the engineering staff, plant of all kinds costing more than $425,000,000 was added to the Bell system in five years, and plant to the value of more than $175,000,000 was taken out and removed from service. Each year large sums are spent in scientific, engineering experimentation and development work which saves millions to the associated companies and their subscribers.

One of the year's developments was an underground cable which in its diameter of 2⅝ inches carries 2,400 telephone wires.

From a legal standpoint the Bell system is in an excellent condition, there being, the report says, no suit pending against the American Telephone and Telegraph Company or any of the associated companies, charging any violation of any state or federal anti-trust law.

NOT PROFIT SHARING.

Welfare work, pension and sick benefit plans are reported to have demonstrated their practical value. During the year benefits were paid in 20,915 cases of disability or death, and at the end of the year 211 former employes were being carried on the pension rolls. The total amount expended for all classes of benefits was $1,338,261, most of it among the lower salaried employes, to whom the loss of wages, even for a short period, would have been a hardship. The recent offer of stock at a low price on installments was intended as an encouragement to saving, and over 30,000 employes availed themselves of this offer.

This has been termed by some "profit sharing." It should not be. It is an investment by which the employe becomes also a proprietor, and he occupies the dual relation of proprietor and employe, which if it can be worked out to its fullest possibilities will be ideal.

In this connection it is shown that for each employe there is an average investment in plant of $5,338, which gives a gross revenue per employe of $1,408, of which $656 is distributed in wages, $79 in taxes, $337 in supplies and expenses, $271 as charges for capital, and $65 reserved for contingencies.

It takes an investment of nearly four dollars to earn one dollar in gross revenue. This dollar of gross revenue is divided. Forty-six and one-half cents are paid in wages to employes, five and one-half cents go for taxes and twenty-four cents go for material and other expenses, a very considerable part of which ultimately goes for wages, leaving as a net operating revenue twenty-four cents, of which about twenty cents pays for the use of the four-dollar capital invested. The remaining four cents of surplus revenue are actually expended for plant additions of which about one-half is for wages.

In any enterprise, even of small magnitude, capital is as necessary as are employes. Without capital there can be no employment of workers. Without workers there can be no employment of capital.

The report shows how soundly the Bell system is financed, even as compared to government undertakings.

ADMINISTRATION.

An interesting description is given of the development of the Bell organization from the time when electrical science was in its laboratory swaddling clothes and the telephone was called a "Yankee toy," for which no proper financial support could be obtained.

It is shown how the local companies were organized and how the need of a common remedy for a common trouble, resulting in a central clearing house and finally in the centralized general administration with its enormous economies, its wonderful contributions to the perfection of the art and the value of the service, now the premier service of the world.

CONTROL AND REGULATION.

As far as Mr. Vail can forecast the future, regulation and control by commissions or business courts have become a permanent feature of our economic laws. He points out that these processes could not be perfect from the start but are being improved.

It is for the public to combine, to encourage, support and sustain all these courts and commissions and the judges and members of commissions, and above all to abandon con-

demnation of all conclusions when they differ from selfish desires or opinions based on one-sided and insufficient information. It is for the public to realize that any particular gain, if at the expense of other interests, is no permanent gain at all, that all business or public prosperity is based upon each party to any transaction getting some benefit from it.

And above all, if there are to be courts of commerce or commissions then the settlement of all matters which have been referred to such courts by the legislature should be left to them.

TELEPHONE CONDITIONS.

An increase of 515,976 telephone stations has been added to the Bell system during the year, despite the retardation of growth. Also 1,364,583 miles of wire for exchange and toll service were added during the year, in the Bell system alone, not including the additions by connecting companies. In traffic the number of messages shows the small gain of slightly over two per cent.

Most of this retardation of growth occurred in the latter half of the year and steps were at once taken to reduce the expenditures for new construction by postponing such extensions as were not immediately necessary, with the result that the additions to the plant, which at the beginning of the year were estimated to aggregate $56,000,000, were only $50,000,000.

For the year 1915 it is estimated that the current additions to plant will aggregate about $35,000,000 and construction work is now proceeding on that basis. The general business conditions, particularly as they affect the demands for telephone service, are being carefully studied and watched and should they improve as is hoped, the construction program can be promptly increased to whatever extent it seems justified.

The gross revenue in 1914 of the Bell system—not including the connected independent companies—was $226,000,000; an increase of over $10,000,000 over last year. Of this, operation consumed $81,400,000; taxes, $12,200,000, or 1.54 per cent on the outstanding capital obligations; current maintenance, $31,600,000; and provision for depresiation, $41,500,000.

The surplus available for charges, etc., was $59,300,000, of which over $18,900,000 was paid in interest and $30,300,000 was paid in dividends.

The total capitalization, including inter-company items and duplications but excluding re-acquired securities of the companies of the bell system, is $1,419,039,668. Of this, $624,324,761 is owned and in the treasury of the companies of the Bell system.

The capital stock, bonds and notes payable outstanding in the hands of the public at the close of the year were $794,714,907.

If to this be added the current accounts payable, $26,214,274, the total outstanding obligations of every kind were $820,929,181, as against which there were liquid assets, cash and current accounts receivable, of $87,066,862, leaving $733,862,319 as the net permanent capital obligations of the whole system outstanding in the hands of the public.

As stated in previous reports, we believe from appraisals made by our engineers that the cost of reproduction of the physical plants of the Bell system would exceed their book cost by some $61,000,000, aside from all intangible values.

The net earnings of the American Telephone and Telegraph Company for the year were $40,557,977.29, approximately the same as in the previous year. The interest charges were $8,223,163.23 and the dividends at the regular rate of 8 per cent per annum were $27,572,674.72. Of the resulting balance there was carried to reserves $2,500,000 and to surplus $2,262,139.34.

The only change in the outstanding capital stock and bonds of this company during 1914 was the issue of $65,600 par value of stock through the conversion of $86,000 of the 4 per cent convertible bonds of 1906.

For the $344,681,900 capital stock, $369,219,358 has been paid into the treasury of the company; the $24,537,458 in excess of par value represents premiums.

The number of shareholders was 59,415 on December 31, showing an increase of 3,432 during the year.

Mention is made of the plan recently announced, by which employes of two years' service or more in the Bell system are aided to become stockholders of the company to the extent of a limited number of shares each, which they are to pay for out of their wages at the rate of $2.00 per share per month. Counting the 30,000 employes in all parts of the country who have applied for shares under this plan, and also those persons whose stock is held for them in investment trusts and the like, there are undoubtedly more than 100,000 actual owners of the stock of the company.

In conclusion Mr. Vail says that the position the Bell system holds with the public is entirely due to the fact that the Bell service has been consistently built upon the policy of creating a service of such great benefit and advantage to the public, and rendered at prices so well within its value to all—so well adapted to the use of all, as well as being a direct pecuniary advantage to each user—that none are too poor to take advantage of it, and none so independent as to get along without it.

To this policy, to this organization, and to every individual member of it belongs the credit of making the Bell system what it is—the premier system of the world.

PRESIDENT THEODORE N. VAIL'S LETTER TO THE DIRECTORS AND SECURITY HOLDERS OF THE AMERICAN TELEPHONE AND TELEGRAPH CO.:

The future of public service enterprises for inter-communication and interchange is something in which you have an indirect interest as members of a great community, and a direct interest in one of the principal enterprises, the telephone. In fact, the question to my mind is so important that the direct interest would be as a member of the community and the indirect as financially interested in one of the enterprises.

There is a condition of disturbance, of economic unsettlement, which cannot continue indefinitely. Either the causes must be removed, or by a period of quiet and freedom from other changes a chance be given for the new conditions to adjust themselves.

Never were the basic conditions of the country better than now for a restoration and continuance of normal conditions. The correction is simple and is pointed out by numerous precedents of the past and by well-established economic laws.

It does seem as if by combined effort of all, right ideas and a right understanding might be brought to bear on the solution of these questions.

While the subject is not strictly pertinent to the annual report of the company, yet in my opinion it is so important that the note of warning should be sounded.

PUBLIC SERVICE.

The most vital of all present economic problems are the relations between the public and public service utilities, particularly those of interchange and intercourse—what constitutes proper regulation and control?—what is the best method of securing their proper maintenance and further extension?

Movement is life—intercourse and interchange are the basis of civilization and commerce.

The quantity, quality and convenience of the means of intercommunication determine the prosperity of the community, for on them depend the degree of interchange of thought and of commodity—the degree of civilization and of commerce.

The demand for any production creates its value. The demand depends upon available fields of consumption made accessible and convenient by adequate and efficient facilities of intercourse and interchange.

The United States of today, in all its magnificence, has been credit—its latent possibilities made tangible, its prosperity maintained, its growth continued—by or because of these means of intercourse and interchange. The maintenance and continued growth of this prosperity will be in a great measure dependent upon the maintenance and continued growth of the utilities which furnish these facilities. All other utilities or industrial or commercal enterprises are subordinate to and dependent upon them.

Until proper relations are established between the public and the public utilities, there cannot be too many repetitions of their importance, no effort should be spared to emphasize it and

guide the public to right conclusions. Until some popular misunderstandings are corrected it will be difficult to establish proper relations.

It is the generally accepted belief that utilities are dependent on the public rather than the public dependent on them; while neither could exist without the other, means of intercourse and interchange are the advance agents. Competition, control, regulation and legislation have been looked upon as the causes or forces which have enabled or compelled industrial enterprises to improve and extend their service; to increase production; to pay increased wages and taxes; and at the same time to decrease charges for service rendered. While these have been to some extent a stimulus, the wonderful improvement which has been made has been coincident and indissolubly connected with the replacement of the old "rule of thumb" methods by methods of scientific operation. *Investigation, research, and the application of the results to both operation and production have produced "much more" and "much better" from the same or less effort and expenditure, and have obtained valuable products from what had heretofore been wasted; much to the benefit of the worker, the public served, and of those responsible for the work.* There is a lack of consistency in the understanding respecting enterprise and initiative, and the relations between capital and labor, the employer and the employe. There are many ideals and beautiful theories which in time we hope may be realized. But commerce and industry are dependent upon the purchaser and consumer and so long as the human factor of self interest as it now exists controls them in their dealings so long must the effect of that *same* existing human factor be taken into consideration by commerce and industry in their relations with both producer and the worker.

The situation in the past has been aggravated, public indignation aroused, and public action influenced, by misleading and wilfully mistaken statements of irresponsible demagogues and impractical theorists. There may have been some lack of a sense of reciprocal obligation on the part of some corporations and their servants to the public. There may have been some abuses, but even if the worst that has been asserted was true they were not of the kind that could have brought about existing conditions, which arise from an imposed reduction in revenue and an imposed increase of expenses. The public in turn has attempted to bring about ideal conditions through the power of control and regulation. This power has resulted in some cases in the impairment and even in the destruction of property rights and of the physical property involved.

Happily, those abuses that existed are passing, and there is evidence of better understanding and appreciation, and more substantial justice on both sides. The public, and particularly those dependent on employment, will soon realize that the wealth of this country does not consist of tangible tokens of value that can be realized upon at will, but that it largely consists of property, or certificates representing property, which has been created by the investment of their savings in these enterprises of utility and industry. The returns from and the intrinsic value of these enterprises depend on the activity caused by demand for the products or service produced by the employment of workers. Without that activity employment ceases, returns disappear and values are dissipated.

Public service enterprises when prosperous are large employers of labor and large purchasers and consumers of all varieties of products and manufactures. Their activity means employment and circulation of money, which in turn means further consumption of products and manufactures and the further employment of labor. Employment means ability to purchase. Ability to purchase means consumption. Consumption means production, and production for which there is a demand means prosperity. Abundant employment makes the worker his own master. He can afford to purchase and consume production. Without employment he is a burden on his savings, his friends or on the community.

It is a great revolving circle of civic and industrial conditions, no beginning, no ending. So long as it is unbroken, so long as each condition is balanced by the others, so long as all changes in conditions are allowed to take place by evolution from old to new, or so long as these changes take place with sufficient deliberation to allow other conditions to become adapted to the changes, so long all will go well and there will be peace, prosperity and progress.

In such times and such conditions everything goes so smoothly that economic life seems commonplace and monotonous; then come the revolutionary changes brought about through those who are too indifferent, careless and unthinking to resist the influence of too radical theorists.

When the balance is broken by these changes, and the relations between the conditions are changed faster than any adjustment between them can take place, then will come disturbance. Continued disturbance is inevitably followed by disaster.

To maintain present conditions only, or even obtain actual though not normal increase, does not mean progress and is not a sound economic position. It is the normal increase that must be had if we are to maintain our relative position and provide for the millions yearly added by new generations and new immigration.

The entire public, working or investing, will all stand by and uphold a control and regulation which will be thorough and effective and at the same time equitable, just and practical. *But has the public ever remained complaisant when it is brought face to face with disturbance, uncertainty and unemployment, caused by too drastic action or too radical legislation upon economic conditions or industrial enterprises?*

Control and regulation can make unnecessary demands upon the time of those who are responsible for operation; they can become destructive instead of constructive; they can by delay paralyze commerce; they can through the inexperienced in operation impose unnecessary burdens and unnecessary expenditure upon corporations; they can impose or require too many regulations and theories of operation and too many undeveloped experiments in plant and equipment; they can very easily run into operation. Demands of labor for increased wages and shorter hours, and demands of the public for increased service, must be met by increased revenue produced by increased rates. The application of scientific and improved methods to operation produced great results in reduction of expenses because it had an unworked field to start with, but it cannot be expected that the same ratio of progress will be indefinitely maintained. *The irreducable minimum in unit expense has been reached in some industries and soon will be in all.*

A corporation, no more than an individual, can be bound hand and foot and yet be active or give good service.

If too many burdens are put upon corporations, and no relief given them, it will be impossible for them to properly operate or maintain their plants. Poorly constructed, badly maintained and inefficiently operated utilities cannot give good service. Inadequate revenue would make it impossible to meet capital charges. Capital would avoid any enterprise which had to do with public service. Without capital, employment in any large way would cease, extension and improvement would be stopped, values would be destroyed, and the enterprise would become bankrupt.

When service is rendered by starved or bankrupt corporations in the hands of receivers, results must follow which will be disastrous. The indirect losses to the public will be far greater than the direct loss to the investor. Decline in prosperity will come to any community dependent upon such corporations. No community with inadequate and inefficient facilities for intercourse and interchange can compete with communities with adequate and efficient facilities.

Bankrupt public service, in time, means bankrupt communities.

It will not then be the mythical money trust or the prominently rich that will have to be dealt with, but it will be power of the nation, the millions dependent upon their daily employment, whose savings are invested in that which represented progress and prosperity, and who are brought suddenly face to face with destruction of values, loss of savings and unemployment.

DISTURBANCE OF STABILITY AND CONDITIONS.

There are three principal creative divisions of industrial enterprises: "Industries producing from the earth," of which agriculture is the most important— "manufacturing"—and "Public Service," which is very largely transportation and intercommunication. All other industries or professions are subordinate to or dependent upon these principal industries; and their rise and decline directly connected with them; they are creative only to the extent that they organize, develop or promote trade and commerce, production and consumption.

Production from the earth is the primary industry, but is dependent upon the broad distribution only to be obtained through means of transportation and other facilities of intercommunication.

Manufacturing is the barometer which indicates the improvement and decline of the conditions of commerce and trade.

"Transportation" and "Intercommunication" are the most important of all in their creative effect. They are the industries upon which depend all interchange and movement, all commerce and trade except that which is purely local. Transportation and intercommunication change local stagnation into world-wide in-

terchange and prosperity. Their relative economic importance as to other industries is many times their relative capital.

During the quarter of a century just past these three principal industries increased about two times and now represent about $100,000,000,000 of invested capital. This development and this new wealth of $65,000,000,000 in these enterprises alone was made possible by and was coincident with the development of transportation.

The capital invested in public service and manufacturing increased during the quarter of the century at the rate of nearly $1,500,000,000 per year; the number of employed increased about 100 per cent and their yearly compensation over $3,500,000,000 or 130 per cent. In enterprises of transportation and intercommunication the capital increased over $15,000,000,000 or an average of $600,000,000 per year; employes over 175 per cent, with an increase in yearly compensation of $1,350,000,000 or over 200 per cent.

Prior to the quarter century agricultural products were largely in excess of domestic consumption; agriculture in the Atlantic states was suffering. At the end of the period, because of increased employment and purchasing power, the domestic consumption of agricultural products had about overtaken production, which had more than doubled in average yearly value. The agricultural interests of the Atlantic states were rapidly reviving.

The normal employment in the public service and manufacturing industries alone should be at the present time nearly, if not quite, 12,000,000 with annual earnings of from $7,200,000,000 to $7,500,000,000.

All employment is far below normal. There are fully 2,000,000 unemployed, whose yearly earnings should be at least $1,250,000,000. These unemployed are now living at the expense of their savings, their friends, or the public. If they were employed, normal conditions would be restored, the circle of interdependent conditions would be balanced, prosperity would be restored.

Capital invested in "Transportation" and intercommunication constitutes one-half the combined capital of public service and manufacturing. It is entirely in the form of negotiable securities, while a large part of the other capital is closely held or not readily realized on. Transportation securities have been for years a favorite investment for capital by the small investor, the trustee, the savings bank; by the most conservative in good times and by the wise investors in bad times; *any cause that disturbs these enterprises disturbs all,* both industrially and financially.

The disturbance, uncertainty and timidity about "Transportation" due to legislative requirements and the increased payments to employes, without any corresponding increase of gross revenue to meet them, have caused increase in expense of operation which can no longer be met by reduction of operating expenses or by scientific methods, for the irreducible minimum has about been reached.

The decrease in the surplus operating revenue has cast doubts upon the safety and certainty of not only the charges on the capital but the capital itself. Except for a few favored lines the safe margin has been so reduced that investors have become frightened.

Extension and improvement of our transportation facilities for which capital is required are necessary. Money in sufficient quantities or on reasonable terms cannot be obtained. Nothing that can be postponed is being done. Unless soon made, the increasing demands of the country as a *"going"* concern cannot be satisfied, to say nothing of our country as a *"growing"* concern.

If there could be a restoration of conditions which would inspire confidence in their securities sufficient to command the capital with which to begin the expenditure of even a part of the $1,000,000,000 a year needed to put these enterprises in a position to meet the demands of the country, both as *"going"* and as a *"growing"* concern, it would soon restore the normal conditions of employment, expenditure, consumption, production. The circle of industrial conditions would be again balanced, shops and factories would be filled, and instead of the bread line there would be a working line night and morning between places of employment and homes.

During the past quarter century progress was steady and continual, except when the over-sanguine or over-grasping were buying, on credit or small margin, intangible though possible future values, or when attempts were made to improve existing conditions by sudden changes.

The public mind, which has been excited and influenced by exaggerated, misleading and mistaken statements of irregularities, realizes that most of them had no foundation in fact. Those that did exist cannot be repeated; business conscience and public morals, as well as regulatory laws, will not permit. Other irregularities will creep in, for where there is abundance produced by labor there will be many who want a part of it without labor. Take the fetters and restrictions off the employment market, keep a good watch on those who do not want to labor, and punish those who betray confidence. Wealth never will be distributed equally nor always employed wisely, but where it exists in abundance there is always a chance for those who are willing to exchange their labor for some of it.

Eastern Pennsylvania Independents to Convene

Representatives from independent telephone companies throughout eastern Pennsylvania, part of New York, Virginia and West Virginia will gather again April 7 and 8 for the second annual convention of the Eastern Pennsylvania Independent Telephone Association. The headquarters of the convention will be in the Cumberland Valley Telephone Company's building. The sessions of the convention will be held in the old Board of Trade building.

The convention will be a joint gathering of the Eastern Pennsylvania Telephone Association and the Western Pennsylvania Independent Telephone Association. It will be addressed by W. S. Vivian, of Chicago, secretary of the Independent Telephone Association of America, on "Standard Operating Rules." Other speakers will be on the program which is now being prepared. There will be many interesting exhibits on display by several of the large telephone manufacturing companies.

The present officers of the Eastern Pennsylvania Independent Telephone Association are: President, Henry M. Tracy, Philadelphia; first vice-president, Mrs. Esther Young, Lebanon; second vice-president, Harry R. Miller, Myerstown; secretary-treasurer, O. K. Kines, Harrisburg. The executive committee includes Mr. Tracy, chairman; Edward M. Prisk, Hazleton; J. F. Stockwell, Philadelphia; Cameron L. Baer, Harrisburg, and Charles A. Carl, Harrisburg.

Commerce Report Shows Increase

The number of telephones per 1,000 population in the entire United States rose from 30 in 1902 to 72 in 1907 and to 91 in 1912. The greatest "telephone density" was found in Iowa, where there were 171 telephones per 1,000 population. California was a close second, with 168, and Nebraska stood third, with 165. The smallest number of telephones per 1,000 population, 21, was found in South Carolina.

The number of messages per capita for the United States as a whole (exclusive of those sent over the lines of companies having annual incomes of less than $5,000) increased from 65 in 1912 to 122 in 1907 and to 144 in 1912. The greatest number of messages per capita during the later year, 282, was reported from California, while Ohio, with 265, and Michigan, with 240, ranked second and third. North Carolina, with 40, had the smallest number of calls per capita.

The net income of the telephone companies with incomes of $5,000 or more increased from $41,200,000 in 1907 to $51,300,000 in 1912, or by nearly 25 per cent, while during the same period the net income of the telegraph companies decreased from $9,650,000 to $6,400,000, or by about one-third.

John D. Rockefeller has seventy telephones in his house and on his estate at Tarrytown, N. Y.—more private telephones than any other man in America.

Telephone Talks

The Third Installment of an Instructive Serial Course for all Telephone Workers

BY G. W. CUMMINGS AND ARTHUR KNEISEL*

THE gavel having fallen, the president looked inquiringly around the room. "I believe that at our last meeting some rash youngster demanded to know what made a telephone talk," he murmured. Somewhat abashed at the spotlight so suddenly turned upon him, the Helper confessed, "I did. Why do you seem to think that there is so much mystery about it?"

"Oh, the rashness of youth!" was the reply. "Rushing in where we wiser ones fear to tread. Well, if you must have it, the Tester has delved deeply into that problem, and perhaps out of his wisdom he can give you a little light on the subject. Even he doesn't know all about it, though."

The Tester rose to his feet. "With this introduction I hardly know where to begin," he admitted. "In its fullest sense that question would take us up to the utmost limit of what we know about high frequency alternating current phenomena, and show us the jumping-off place into the region of what no man knows as yet. Since I don't think that is quite what our young friend means, we will forget that phase of the problem for the present,

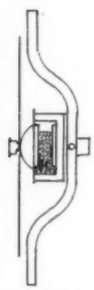


Fig. 33.

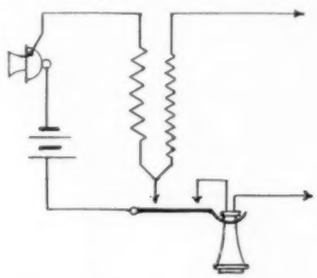


Fig. 36.

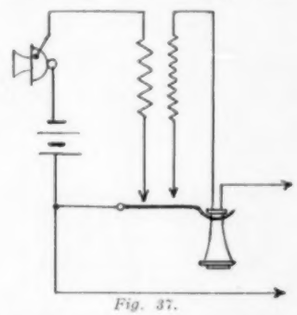


Fig. 37.

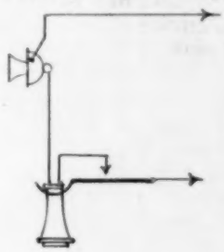


Fig. 39.

and perhaps an explanation of what is necessary in order that a telephone may talk and how our present circuits came to be designed to meet that requirement may answer his question sufficiently and make the work of all of us more interesting by showing us—at least to some extent—why we do things in the way we do.

"The three essentials, of course, are a transmitter, reeiver, and battery; because we need to talk, to hear, and to have current to transmit our speech. A transmitter is, to all intents and purposes, a carbon rheostat which is operated by a diaphragm. You know that carbon has the peculiarity of changing its resistance very greatly under comparatively slight changes of pressure. You also know that speech is transmitted through the air by waves, and if we talk against a diaphragm we set it into vibrations corresponding to the sound waves. If, then, we fasten one pole of a sensitive carbon rheostat to the center of a diaphragm and then talk against the diaphragm, we will vary the pressure on that diaphragm and set up changes in the current through the rheostat in exact step with the sound waves. If we cut a transmitter in two we would find that it looked something like this (Fig. 33).

"Across the back of the transmitter is a heavy brass bridge, and fastened to the center of the bridge is a carbon button, which is enclosed in a brass cup. Facing this button is another one which is mounted on the center of the diaphragm and vibrates with it. The space between the two buttons is nearly filled with carbon in a granular or coarsely powdered form. As the diaphragm vibrates under the influence of the sound waves the pressure on the granular carbon, and consequently the current through it, varies correspondingly. This, then, gives us the means of converting speech waves into electrical waves. There are, of course, other kinds of transmitters besides the one I have drawn, but they all work in the same way, so we will take this one as typical.

"At the other end of the line we have to convert the electrical waves back into sound waves, and we do it by means of a receiver, which consists essentially of a horseshoe permanent magnet, each pole carrying a small electromagnet. Facing the ends of the electromaknets is a thin sheet iron diaphragm (Fig. 34).

"The diaphragm is slightly bowed toward the pole pieces by the attraction of the permanent magnet, and this makes it extremely sensitive to any slight changes in the force of that attraction. A current in one direction through the coils assists the permanent magnet and draws the diaphragm closer, while one in the opposite direction opposes it and allows the diaphragm to spring away. As the diaphragm vibrates it sets the air into motion and in this way converts the electrical waves into sound waves."

"You seem to think that the permanent magnet is quite important," broke in the Repairman. "I used to work on a system where the receivers had no permanent magnets at all."

"Quite true," replied the Tester. "But in that system the receiver was cut in directly on a common battery line, and the line battery through the coils attracted the diaphragm in the same way as the permanent magnet in the more usual form.

"The simplest way in which we can combine the transmitter, receiver, and battery into a workable subscriber's set is that known as local battery, because its action depends on a battery which is local to the set. This I am showing in its elementary form (Fig. 35).

"Tracing the circuit just as we did the doorbell circuit at our last meeting, we find a current flowing from the battery through the transmitter and primary winding of the induction coil back to the battery. The receiver, secondary winding of the coil, and line are all in series,

*Copyright, 1915, by G. W. Cummings and Arthur Kneisel.

so that all the current coming in over the line from the distant instrument must go through the receiver."

"Wait a minute," interrupted the Helper. "You said that the three essentials were the transmitter, receiver, and battery; and now you've lugged an induction coil into it too. What's that for?"

"You could bridge the transmitter, receiver, and battery across the line," was the answer, "or you could put them in series, or use some series-multiple combination; but with any such arrangement the battery would divide its strength between the transmitter and the rest of the circuit, and the set would consequently not talk as well. By putting the battery and transmitter in a local circuit of low resistance and repeating the speech through into the line by means of the induction coil we get a maximum of efficiency with a minimum of battery. Just to show, however, that you could get along without it, I might say that some years ago, when I was a country repairman, I ran out of induction coils and needed one to clear a case of trouble, so I robbed a set which had been shipped out for a new subscriber. Before I got back to the office an installer had taken the set out, installed it, and got his O. K. When he came back he commented on the supposed fact that the company had adopted a new scheme and discarded the induction coil. When I asked him how he made it work he said that he had simply bridged everything across the line. It is needless to say that I borrowed a coil from the next district and got out there as soon as I could.

"I said that putting the transmitter and battery in a local circuit of low resistance gave the greatest efficiency, and perhaps it might be interesting to show why that is true. The volume of transmission depends entirely on how much the vibrations of the transmitter diaphragm can *change* the volume of the primary current. Suppose, for example, that the total resistance of the circuit is 10 ohms and the variation in the resistance of the transmitter as we talk into it is 3 ohms. In that case the variation in the volume of the current is thirty per cent. If, however, the total resistance were 100 ohms, then it is evident that the variation in the current is only three per-cent, and the volume of transmission is reduced correspondingly. I mention this particularly because we will find later that it proved to be the greatest stumbling block in the way of developing the present common battery system."

The Switchboardman had been doing some rapid thinking. "If that is true," he inquired, "why doesn't a local battery set talk better than a common battery? Wasn't common battery a step backward in that respect?"

"Other things—principally battery conditions—being equal, you are right," was the answer. "In practice, however, battery conditions are not equal, because a local battery set is of necessity operated by a primary battery, which begins to deteriorate from the day it is set up, so that the initial advantage is soon lost. In addition to this, we will find later that in the common battery set which is most widely used this local battery action is obtained, in fact it was the principle which led to the design of the circuit in its present form.

"Just a minute, though, before we leave the simpler local battery set. It is necessary that both the receiving and transmitting circuits be open at all times when the set is not in use to prevent interfering with signaling and running down the battery. This is accomplished in practice by looping them both through upper contacts of the switch hook, so that they are open when the receiver is on the hook. Taking the receiver off allows the lifting spring to push the hook up and close the contacts. So long as the conditions we have discussed are complied with, the details of the circuit are entirely immaterial, and as a matter of fact you are likely to find almost any combination. By way of illustration, I will draw two typical ones. The first (Fig. 36), is a simple modification of the elementary circuit we have been discussing, merely tying one side of the primary and secondary together and wiring them to one upper contact of the hook, with the battery going to the body of the hook and the other upper contact going through the receiver to line. Although the primary and secondary are tied together you will notice that we still have purely local battery conditions, because the battery has no way of getting out on the line. Another arrangement is this (Fig. 37), which looks somewhat different, but really amounts to very much the same thing.

These two may be considered as typical of all local battery circuits.

"In a common battery system, as the name indicates, the talking current is furnished by a single large battery which is located in the office and common to all the lines in that exchange, instead of by scattered batteries at the various stations. The resultant economy in maintenance, and uniformity and efficiency in service, are obvious, at least in an exchange large enough to warrant the expense of the somewhat elaborate power plant required. Another important advantage is that since the flow of current is controlled by the switch hook it is a simple step to loop a tip-up signal or a relay into the line at the central office and make the signal entirely automatic, eliminating the crank-turning of the earlier set.

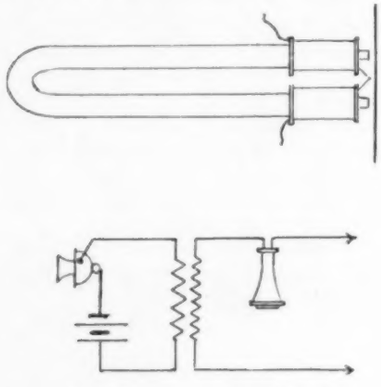


Fig. 34.

Fig. 35.

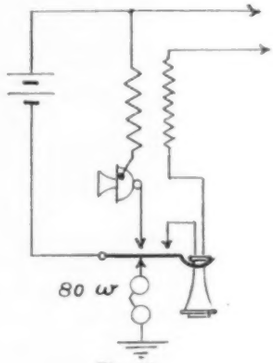


Fig. 38.

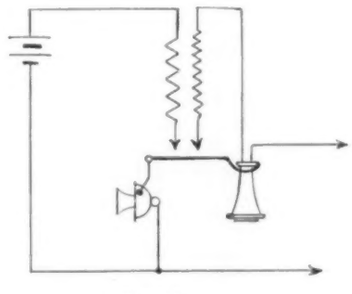


Fig. 40.

"Locating the battery at the office instead of at the instrument was a revolutionary step, and involved serious problems. In every instrument circuit the transmitting portion of the apparatus necessarily causes some loss in receiving, and the receiving portion some loss in transmitting. In common battery work this problem is complicated by the fact that both the battery which supplies the transmitter and the fluctuations which bring us the speech from the distant instrument must travel over the same line wires at the same time, and the transmitter and receiver must be so arranged that each will pick out its own current while interfering as little as possible with the other.

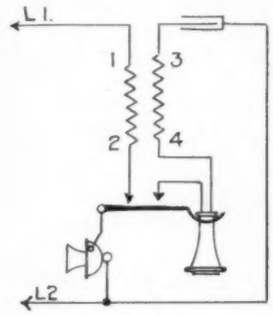


Fig. 41.

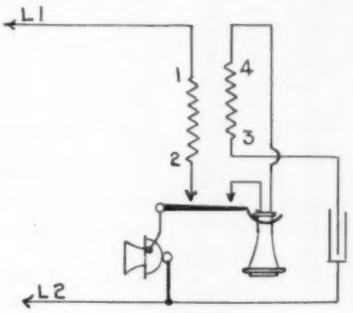


Fig. 42.

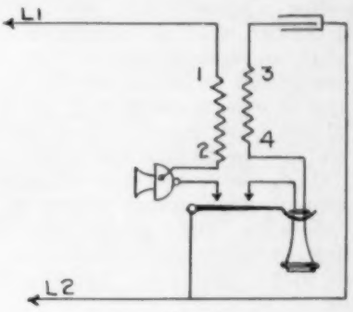


Fig. 43.

"A still more serious problem was the outgrowth of the one we have just discussed. Since the primary circuit necessarily includes the line, its resistance varies with different lines and is in all cases comparatively high; while we have just found that efficient transmission demands that the total primary resistance be kept as small as possible in comparison with the variations in transmitter resistance due to the act of talking.

"With these two fundamental problems outlined, we will take up the history of the evolution of the circuit which is most widely used today, and then discuss some of the other circuits which have attacked the same problems in different ways.

"The first application of the common battery principle was the installation in a central office of a single storage battery to care for the operators' transmitters, replacing the gravity cells formerly used. In this case the problems we have mentioned were avoided by using separate battery leads of negligible resistance to each position and retaining the local battery circuit.

"The Express system was an interesting and—so far as transmission was concerned—a very successful attempt to extend the common battery principle to the subscriber's set. We can illustrate one of its forms thus (Fig. 38).

"A storage battery was used in the set. As shown in the sketch, the battery was charged through the lower contact of the switch hook and through the 80 ohm ringers while the set was not in use. The charging side of the line was connected to the central office battery through a suitable resistance, while a tip-up signal, lamp, or relay was legged from the other side to ground to provide for automatic signaling. Taking the receiver off the hook signaled the operator by a short circuit through the re- the receiver, and at the same time opened the ground through the ringers and put the storage battery in a local circuit, giving the same talking conditions as in a local battery set."

"Wasn't it a good deal of a nuisance to take care of a separate storage battery at every station?" inquired the Frameman, with vivid recollections of the Storage Battery Instructions with which he was expected to be familiar.

"To put it mildly, it was," replied the Tester, "and for that reason it was not practicable for commercial use on a large scale. It was, however, an important link in the chain of evolution.

"The next step was characteristically American in its disregard for precedent and fine-spun theory. The induction coil and local battery were discarded, the transmitter and receiver were put directly in series across the line (Fig. 39), and common battery took its start as a commercially practicable system. Considering that it flatly violated the fundamental principle of low primary resistance which we have found to be so important, this set gave surprisingly good transmission.

"Aside from this fundamental difficulty, the simple series arrangement has several serious drawbacks. It involves drawing the signaling and talking current through the receiver, either strengthening or weakening the pull of the permanent magnet. In addition to the fact that a reverse current will demagnetize the receiver in a short time, it is obvious that to give the best results the diaphragm should be as close to the pole pieces as possible without touching them. Any considerable current through the receiver, by altering the pull of the magnet, alters this spacing; pulling the diaphragm down onto the pole pieces in the one case, or—if reversed—allowing it to be so far away that it loses its sensitiveness. Since the volume of the current, and consequently the extent of this action, varies with the length of the line, it cannot be compensated for by any change in the design of the receiver.

"It was thought by many of us at the time that the difficulty of a high primary resistance had been overcome by using a twenty-four volt battery instead of the three or four volts which had been usual with local battery sets, but as a matter of fact the most of the higher potential is used up in the line and cord circuit. To take a very moderate example the total talking resistance of a station one-half mile from the office, fed by 22 gauge cable, is about 299 ohms, of which the transmitter forms one-tenth. Consequently, the fall of potential through the transmitter is one-tenth of the total, or considerably less than in the case of the local battery set. On a longer line the potential available at the transmitter is, of course, still less; so that with less potential to work with than in a local battery set, the transmitter has to vary the current through a dead resistance load perhaps ten or twenty times as great.

"Other difficulties which are less noticeable, because they are serious only on long lines—especially when the lines are in cable—are that the electrostatic capacity of the line distorts and muffles the speech, and the series circuit offers no way of compensating for this; while the

comparatively high retardation of the receiver, being in series with the transmitter, muffles it still further.

"As experience demonstrated the limitations of the series circuit, various attempts were made to devise an arrangement which would combine the high talking efficiency of the local battery set with the convenience and economy of common battery. This (Fig. 40), shows an interesting scheme which, while it was never put into actual service, was an important link in the evolution of the circuit now in general use. It modified the old Express circuit by so connecting the local storage battery that it was on charge only while the set was in use, thus allowing the use of a much smaller and simpler battery and solving all problems of over and under charging.

"This arrangement was still open to the objection of requiring a messy storage battery at the subscriber's station, and some bright genius suggested the next step by pointing out the similarity between the action of a storage battery and a condenser. Suppose we discuss that for a minute.

"If we dip two lead plates into dilute sulphuric acid and connect one to the positive pole and the other to the negative pole of any source of electromotive force, a current is sent through them which produces certain chemical changes in the plates and acid, and we have a storage cell. If we disconnect the cell from the source of supply and connect the plates together, the strained condition set up by these chemical changes tends to relieve itself by setting up a current in the opposite direction.

"If we place two sheets of tinfoil close together but insulated from each other by a sheet of parafined paper, forming a condenser, and connect one sheet of tinfoil to the positive pole and the other to the negative pole of a source of electromotive force, a momentary current is set up which produces a difference of electrical pressure between the two tinfoil sheets. This strained condition tends to relieve itself by setting up a momentary current in the opposite direction—or discharging—if we disconnect it from the source of electromotive force and connect the two tinfoil sheets together.

"It is evident that the only material difference between the action of the storage battery and the condenser is in their capacity. Since in the last circuit we considered the battery is on charge whenever the set is in use, a large capacity is not required, and the condenser gives practically the same results as a storage battery. This bring us to the circuit now in most general use (Fig. 41.). The use of the condenser also, you will notice, enables us to avoid the difficulties involved in passing the direct current through the receiver by placing it in a local circuit, where it is affected only by the alternating voice currents.

"With a clear understanding of what conditions led to its design, we are now prepared to discuss intelligently what makes this arrangement talk. To make it clearer, we will draw the circuit in a slightly different way in order to represent the inductive action which actually takes place in the coil (Fig. 42).

"Transmission in this circuit is due to two distinct factors. First: As the transmitter varies its resistance under the influence of the sound waves it thereby varies the amount of current flowing in the line, impressing the fluctuations directly upon the line instead of through the medium of an induction coil as in the local battery set. This is a purely common battery action, and the circuit is in this respect superior to the old series arrangement only to the slight extent due to the retardation of the primary winding of the induction coil, which is in series with the transmitter, being less than that of the receiver in the older circuit. This difference is aided somewhat by the fact that the primary winding of the induction coil which is used here is the outsde winding, and is hence less affected by the iron core than if it were the inside winding as in most other coils.

"Second: Since this circuit was developed for the purpose of obtaining in a common battery set the high transmitting efficiency of local battery, it is evident that the condenser and induction coil must play an important part. This brings us to one of the most interesting studies I know of, and while to explain it fully involves all kinds of higher mathematics and a knowledge of high frequency alternating current phenomena, the principle involved is really very simple.

"Since the local circuit is bridged around the transmitter, the condenser is charged by the line battery to a point equal to the difference of potential around the transmitter, which we have found in most cases to be about two volts. As the resistance of the transmitter changes, the fall of potential through it and consequently the charge in the condenser also changes.

"Starting with the transmitter diaphragm at the outer limit of its swing; its resistance, and therefore the charge in the condenser, is at a maximum; while the current is at its lowest point. As the diaphragm swings inward, lowering the resistance, it draws a rush of current from both the line and the condenser. If we suppose the current to be coming in over *L1*, the impulse from the line passes downward through the primary of the coil and through the transmitter to *L2*. At the same time the impulse from the condenser passes upward through the secondary winding and through the receiver and transmitter in series, also to *L2*. In passing upward through the secondary, this impulse induces an impulse in the opposite direction—or downward—through the primary,

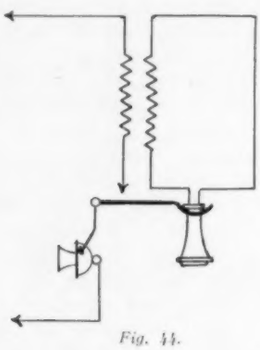


Fig. 44.

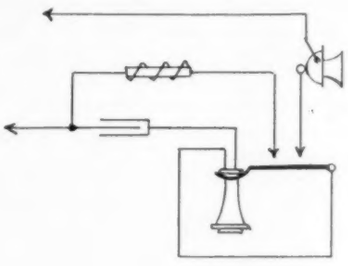


Fig. 45.

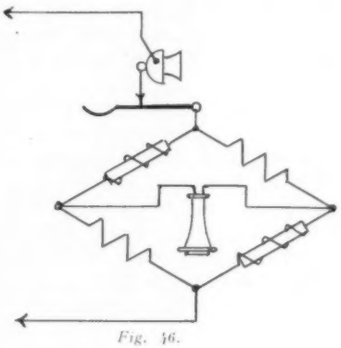


Fig. 46.

thereby 'boosting' the impulse from the line. As the diaphragm completes its swing inward and starts out again, the conditions are reversed; the current from the line is decreased by the increasing resistance of the transmitter, and as the difference of potential across the transmitter—and therefore across the condenser—increases, an impulse is set up downward through the secondary to the condenser; and this impulse, by inducing an impulse in the opposite direction in the primary, opposes the line current and aids the increasing resistance of the transmitter in cutting it down.

"We have in this circuit a combination of common and local battery action, then, both working together to produce the maximum volume of transmission. A fact which is not so simply explained is that its transmission even on long lines is very clear, due to the fact that the inductive conditions in the circuit balance, in a way of which its originators probably never dreamed, the lagging distortion caused by the distributed capacity of the line, acting in this way very much like a loading coil. On short lines almost any kind of set will talk satisfactorily, but when the lines are long, and especially when they are in cable, this action makes all the difference between success and failure in a connection. It is only by utilizing every possible advantage like this, whether accidental or carefully studied out, that it has been made possible to talk from the Atlantic to the Pacific."

"I think I get your idea on the transmitting," broke in the Repairman, "but how do we hear? By induction through the coil or by conduction through both windings in series, or both?"

"By induction entirely," was the answer. "Suppose we trace it out and see. Tracing an impulse coming in over *L1*, as it passes downward through the primary it induces an impulse upward through the secondary. This induced impulse flows around the local circuit through the receiver, condenser and transmitter. When the original impulse reaches the hook it finds a choice of paths; one through the transmitter to *L2* and out, the other through the receiver, secondary of the coil, and condenser, also to *L2*. The impulse will divide in inverse ratio to the impedence of these two paths, much the larger part going through the transmitter, which is, of course, non-inductive. The portion which flows through the secondary circuit is in the opposite direction to the induced impulse, opposing and weakening it to some extent. This causes a slight loss in receiving, but in practice the loss is so small that it can be detected only by the most careful tests. As a matter of fact, I never knew but one man who could pick it up with any degree of certainty, and he was a musician who had a wonderful ear."

"I had a case of 'Can't hear' on a telephone in the front of a store on a noisy street car line today," said the Repairman, "and I fixed it up fine by cutting it antisidetone. Why didn't you let me leave it that way?"

"I believe I caught it when you called in, from the fact that although you could hear me all right I couldn't hear you as well as I ought to," answered the Tester, "and it sounded rather flat. Suppose we draw it up and find out why (Fig. 43).

"The only difference is in taking the transmitter out of the condenser circuit, leaving the condenser, receiver, and secondary of the coil purely local. This improves the hearing in two different ways. First, it eliminates the slight loss due to the two opposing currents in the secondary circuit. Second, it lessens the effect of the noise in the room by destroying the constant charge and discharge of the condenser which we have found to be the essential feature of this circuit in transmitting. This, by the way, gives us a line on just how important this condenser action is, because by destroying it we bring in a transmitting loss equivalent to that caused by adding from two miles and a half to seven miles of cable to the line.

This transmitting loss far overbalances the slight gain in receiving, and is entirely too great to allow on a set which may be used for a long distance call, as any set is likely to be."

"Is this the only circuit in use?" inquired the Installer.

"Hardly," replied the Tester. "There are almost as many circuits on the market as there are manufacturers, but it is getting rather late tonight to attempt to discuss them all.

"I have gone somewhat into detail on this circuit because it is the one which the most of us use, but there are at least three others which, because they have been rather widely used, might be worth our while to spend a few moments on.

"An idea which has been foremost in the minds of nearly all circuit designers is to keep the line battery out of the receiver. In the circuit we have been considering this is accomplished by the condenser. Another and simpler arrangement which has been extensively used is this (Fig. 44).

"Here the transmitter and primary of the coil are directly across the line (through, of course, a switch hook contact), with the receiver and secondary in a local circuit.

"While satisfactory for local exchange use, and it has simplicity in its favor, this plan does not provide any of the local battery effect which we have been talking so much about.

"Another circuit which has come into considerable prominence is this (Fig. 45) which does away with the induction coil entirely and uses a retardation coil instead. The principle here is simply that of keeping the line battery out of the receiver by means of a condenser and supplying current to the transmitter through the retardation coil. This coil is, of course, a shunt across the receiver, but its high retardation prevents any material loss.

"A still more radical and ingenious departure from previous practice discards not only the induction coil but the condenser as well, and accomplishes the object of keeping the battery out of the receiver by utilizing the principle of the balanced bridge (Fig. 46).

"We have not the time to go into an analysis of the Wheatstone bridge tonight, but to those who are familiar with it I need only say that the four arms are balanced from the standpoint of simple resistance, so that none of the direct current which is needed for operating the transmitter and the line signals will flow through the receiver, while the fact that two of the opposite arms of the bridge are inductive and the other two non-inductive unbalances the bridge to alternating and fluctuating currents, forcing them to travel through the receiver.

"We have only touched lightly upon a few of the more important points of these circuits, and there are many other circuits in use. I could talk a week along this line without covering them all in detail, but as we all have a full day's work to do tomorrow I move we adjourn."

"Carried," said the Chairman.

(To be continued)

Iowa Independents Hold Nineteenth Convention

Regulation of telephones by the Iowa State Railroad Commission and making them common carriers was the subject which attracted the greatest interest at the opening session of the Nineteenth Annual Convention of the Iowa Independent Telephone Association at the Chamberlain hotel, March 10. The program was varied and contained papers on accounting and reports of several committees as well as the president's address.

In his address President H. L. Beyer spoke of the convention as a radical departure toward the practical from the usual run of such meetings. Most practical of the innovations introduced this year are the schools for operators and plant men, conducted by the engineering extension department of the Iowa State college.

The report of the secretary-treasurer, C. C. Deering, included a report on the work of the traveling instructor of operators, Miss K. M. Gang. H. B. Shoemaker reported on the work in connection with the extension department at Ames. J. M. Plaister of Fort Dodge presented a paper on the "Interstate Commerce Commission's Accounting System for Class C Companies."

An explanation of the war tax on telephone calls was presented by F. B. MacKinnon of Washington, D. C., secretary of the National Independent Telephone Association. His remarks were supplemented by E. B. Fisher of Grand Rapids, Mich., president of the Independent Telephone Association of America. He advocated the placing of telephone service in a class with that of other common carriers and in having it regulated as such.

The report of the business committee on legislation closed the meeting. The Francis-Jones bill on telephones was explained analytically. Mr. Holdoegel surprised many of the members of the association with the statement that there is one telephone for every five persons in the state of Iowa, the highest per cent of any state in the union, and yet there is no telephone regulation in Iowa. Further action on the matter will be taken after the report of the resolutions committee.

The program included a paper by W. S. Vivian, secretary of the Independent Telephone Association of America, on "Cooperative Operation;" a paper by H. G. Addie on the "Merit System of Paying Operators;" a question box session, the election of officers and the report of the resolutions committee.

Protest and concentration of effort and influence against the practice of telephone manufacturing companies of stirring up dissatisfaction with existing independent companies and of starting up new companies in order to sell them their supplies was the gist of the resolutions adopted by the Iowa Independent Telephone Association in their final session. The three-day convention closed with the election of officers as follows: H. B. Shoemaker of Toledo, president; Charles C. Deering of Des Moines, secretary-treasurer, and the executive committee composed of the president and H. L. Beyer of Grinnell, O. L. Loudenslager of LeMars, G. E. Atkinson of Creston, and P. C. Holdoegel of Rockwell City.

Papers and addresses were given at the final session by H. D. Currier of Chicago, who spoke on "Electrical Transmission," and L. L. Hill of Minneapolis, who gave an illustrated lecture on "Poles and Pole Preservation." Brief addresses were made by C. Y. McVey of Cleveland, president of the National Independent Telephone Association; H. B. McNeal, and Leroy Parker, chairman of the accounting department of the national association.

The report of the resolutions committee, which was adopted, urges all members of the association and all other independent companies to purchase apparatus from recognized independent manufacturers only. It also requests that in so doing they ask the manufacturers to show their willingness to refrain from promoting or in any way encouraging the duplication of telephone plants in territory now reasonably served by independent companies. This duplication they declare to be detrimental to the public and to the independent movement at large.

Des Moines was chosen as the place of the meeting to be held in March, 1916.

First Meeting of Standardization Committee

The committee appointed at the last annual convention of the Independent Telephone Association of America for the purpose of establishing standards applicable to independent telephony, had its first meeting in the Association rooms, Chicago, March 22 and 23. The committee consists of:

W. H. Hay, service engineer, Western Pennsylvania Independent Telephone Association, Pittsburg, Penn., chairman.

A. J. Seymour, engineer, Tri-State Telephone and Telegraph Co., St. Paul, Minn.

A. J. Shands, traffic manager, Kinloch Telephone Company, St. Louis, Mo.

J. M. Storkerson, superintendent, La Crosse Telephone Company, La Crosse, Wis.

W. J. Melchers, general manager, Union Telephone Company, Owosso, Mich.

F. O. Cuppy, general manager, Lafayette Telephone Company, Lafayette, Ind.

Carl Sherrer, engineer, Keystone Telephone Company, Philadelphia, Penn.

Various methods of procedure were discussed, as also the particular branches of the industry requiring urgent attention.

The committee decided to devote its attention first to the various phases of transmission, and after discussing the component parts involved, it was deemed advisable to invite engineers representing the manufacturers of central office and sub-station apparatus and get their views and suggestions regarding standards of transmission. As sponsor of the idea, H. D. Currier, chief engineer of the Kellogg Switchboard & Supply Company, gave the committee his views regarding the scope of the work, stating that while the work at first must necessarily be slow, immeasurable benefit will be derived from established standards.

The committee adjourned until April 23 and 24, at which time manufacturers' engineers will be heard and work will begin in earnest.

It is intended to outline the work so as to establish standards relating to toll transmission and connections to apparatus operating in smaller exchanges which heretofore have not had the advantages of special engineering.

Applications of Theory to Telephony

Address Before the Independent Association's Convention at Minneapolis

BY PROF. GEORGE D. SHEPARDSON*

MANY people think telephony is very simple; look in the directory for a number, take down the receiver, call the number to the operator, wait a few seconds, talk to the party desired, hang up the receiver, and pay the bill before the fifteenth of the month in order to save the discount; a child can do it, and the simplest can understand it. As a matter of fact, these apparently simple operations involve directly or indirectly a large part of human knowledge and experience. The following remarks are intended to show some of the ways in which telephony involves and depends upon various lines of knowledge and experience which have been so developed and classified as to be expressible in the form of definite laws.

The development and application of the fundamental laws which express the ways in which Nature works in any line of activity may be considered as the theory of that subject. The early stages of development of a theory may be considered as only hypotheses, or tentative suppositions, or guesses at the way in which Nature works; but after more extended experience and philosophical analysis, the workings of Nature come to be better understood and their tentative explanations develop into theories. When properly developed and properly understood, theory should not only explain phenomena which have already been observed, but should also enable one to predict with reasonable assurance what result may be expected when new conditions arise. Theory should also point out the way more or less distinctly to the determination not only of the possible ways to secure desired results, but may also point out the best way to reach them.

Theory and practice are usually developed together, sometimes one being further advanced and then the other. To secure the best results, whether in telephony or in any other field, theory and practice should go hand in hand. A hearty welcome should be accorded every addition to knowledge, whether coming through the practical or through the theoretical route, for every addition to knowledge tends to improve our facilities.

Theories may assist in the proper understanding and in the development of telephony in many ways. These may be considered in two general classes, which overlap to some extent, namely the human and the physical aspects of telephony.

THE HUMAN SIDE OF TELEPHONY.

The human side of telephony should be understood both in theory and in application. The laws which govern the mind, those which govern the body, those which govern the relations between people, whether with investors, fellow-servants, subscribers, or with the community at large, whether with the individual, the municipality, the commonwealth or the nation, these laws which apply more or less to every business are especially important to the conduct of the telephone business.

In order to handle people most successfully one should understand the laws which govern the mind. The laws of psychology and of logic have frequent application in the relations between the company and the public, not only in formal reasoning but also and increasingly in cultivating and utilizing sub-conscious influence and in directing sub-conscious cerebration.

The laws of mental suggestion, of self-interest and of delegated judgment are involved in the selection and securing of the right kind of local men as stockholders and as officers in the early and late stages of promoting and developing the company. It goes without saying that the successful manager of a telephone company must be acquainted with the principles and practice of finance and of business management, and either personally or through counsel, must be familiar with the laws of the municipality, state and nation, at least so far as they may affect his business.

The laws of formal logic and argumentation should be familiar to those representatives of the company who have to do with securing franchises and rights of way. Both logic and sub-conscious cerebration are sometimes required to secure a right-of-way, or to convince an objecting property owner that trimming his trees so as to avoid interference with wires will also improve their looks and may even enhance the value of his property.

The laws of salesmanship and the recognition of the psychological moment are applicable to telephony as to other lines of business. It takes both knowledge and skill to prove to the public that competition in a so-called natural monopoly, such as the telephone business, is of advantage to the community. It takes a knowledge of human nature and more or less finesse to secure subscribers for the smaller of two competing exchanges.

JUDICIOUS PUBLICITY.

Recognition should be made of the value of judicious publicity, as means of training the public to recognize the value of the telephone both in regular service and also in emergency cases. For example, the telegraph sprang into public favor at one bound in England in 1845 as a result of the announcement of how it was instrumental in arresting a murderer who had jumped on a train immediately after committing his crime, but whose description was telegraphed to the stations where the train was to stop. In later times the telephone and the wireless telegraph were looked upon as scientific curiosities, until their usefulness in actual business was established. Even today, the public needs to be reminded occasionally of the effectiveness of the telephone in times of emergency, as in the sudden checking of the panic in 1907 by the concerted action of the bankers of the country who, between Saturday noon and Monday morning, arranged for simultaneous and universal action in all parts of the United States; the thrilling story of how the loss of life by the Johnstown flood was reduced by prompt use of the telephone has been duplicated several times since, though the publicity was less; the not infrequent instances where help has been summoned by the effective use of the telephone in cases of fire, sudden sickness or fear of burglary, might be used much more effectively at the psychological moment by securing wider publicity through the daily and periodical press, if telephone people appreciated more fully the direct and indirect value of impressing

*Professor of Electrical Engineering, University of Minnesota.

upon the public mind the indispensability of this means of communication, and using the occasion to cultivate a more friendly attitude toward the telephone systems and their owners. Incidentally they are suitable occasions to run special advertisements urging people to have telephones in their houses, to have extensions convenient to various parts of the house and perhaps to have portable telephones with long cords near the bed for night service or for greater convenience of the sick in summoning attention or in helping pass the tedious hours by conversing with distant friends, or in listening to concerts or other entertainments.

TELEPHONE COURTESY.

Less directly controllable, but not the less important, is the application of the laws of mind to the relations with and between subscribers. Managers may well study and try to improve what might be called "telephone courtesy" both as between subscribers and as between them and the company. While the imperious call of the telephone bell is recognized as the quickest means of getting the attention of a busy man, the query frequently rises as to whether it is not more of a nuisance than of a convenience, and every effort should be made to minimize its irritativeness. To be met with the demand, "Who is this?", when answering the telephone, is apt to put one on the defense immediately and to induce a subconscious feeling that the telephone itself is partly responsible for the annoyance. Incidentally, the habit of introducing a conversation by demanding the identity of the party responding, may be chargeable to an unduly frequent experience with misunderstood numbers and other false calls. Next to receiving a false call in the middle of the night or at other inopportune time, is the not infrequent annoyance from the party that instructs his clerk to "get" a certain party, who is then invited to "Wait a minute please," while the called continues to do something else. Such annoyances are partly offset by the facility with which one may cut off a tedious communicant by accidentally signaling the operator to cut off the connection. Slow service, noisy lines and poor instruments may add their quota to the frame of mind of the subscriber toward other communicants and toward the company and the system. The whole relation between subscribers constitutes a problem in psychology and other phases of human nature worthy the careful study of managers.

RELATIONS WITH EMPLOYES.

The laws governing the human side of telephony may be applied more effectively in improving the relations between the company and the employes and thereby indirectly with the general public. Employes who cultivate the habit of speaking of "our" company and of "our" practice, or of what "we" are expecting to do, instead of what "they" do, exert a benign influence upon the subconsciousness of the public who are won't to think of corporations as being soulless. The up-to-date operator who courteously replies "Will you excuse us, please?" exerts a very different influence than that of the former operator who insisted that she did not ring a subscriber that is somewhat peeved from answering a false call. The complaint clerk and the trouble man should be past masters of the knowledge of human nature and the laws of suggestion. The suave and knowing clerk may assume in each case of dispute that the customer is right, for indeed he sometimes is.

As it comes to be better understood that one can do the best work, whether mental or physical, when the body is in good condition, more and more employers are undertaking various forms and degrees of so-called welfare work to improve both body and mind of the employe, the investment being returned in higher efficiency. The psychological effect of working amid pleasant surroundings and under comfortable conditions is found to warrant judicious investment.

Closely allied as a means of improving service, is a study of the attitude of mind of the employe toward the company. The use of the "suggestion box" through which employes are invited to offer suggestions as to the improvement of the service or other matters of interest to the company is likely to stimulate more intelligent interest, especially when honorable mention or more substantial consideration is awarded to those who initiate real betterments. The encouragement of more ready access between employes and the higher officials of the company is likely to have a benficial psychological effect upon all parties concerned. The employe who feels that he is a real working unit in the organization, that he is recognized as an intelligent part in a growing and developing co-operative industry is thereby stimulated to stronger team play. Employes who are enabled to secure ownership of some stock, however small, or who are made participants in the net earnings of the company by some other system of profit sharing, have a stronger incentive to help effect economies in operation and to maintain the service at highest efficiency. In short, a careful and intelligent study of the recognized and the sub-conscious influences over the minds of the employes may do much to improve the *esprit-du-corps* within the organization.

OPPORTUNITIES FOR ENGINEERS.

The telephone field has not secured its proper share of technically trained engineers. This is a result of four principal causes: First, the applications of theory to telephony have not been sufficiently recognized or emphasized; second, too many engineering students measure the importance of a field by the size of the units and by the amount of energy involved; they are apt to belittle telephony because many of the operations involve milliwatts instead of kilo-watts; third, there has been a lack of systematic and satisfactory books on the theory of telephony; fourth, most of the manufacturing and of the operating telephone companies have not sufficiently appreciated the possibilities of improvement by the proper use of suitably trained technical men. Yet there are few fields of electrical development which offer better opportunities for strong men with sound theoretical and practical training, and whose financial leaders better appreciate the value of well-trained engineers. An analysis of the careers of the electrical engineering graduates of one of the technical schools shows that more than ninety per cent of those who have entered the telephone field have been satisfied to persist therein, a larger percentage of stability than that in any other single field of electrical engineering.

THE PHYSICAL SIDE OF TELEPHONY.

Turning to the physical side of telephony, there has been so much of the "cut-and-try" and so much of the "copy-as-closely-as-one-dares" element in the development, that there is a too prevalent idea that telephony is all practice and no theory. It must be confessed that there has been much groping in the dark, and that many of the improvements have been stumbled upon rather than invented. Yet the design, construction and operation of telephone exchanges, lines and subscribers' sets involve

a large part of the fundamental principles of physics, chemistry, mathematics and engineering, and many special applications and developments.

THE RELATED SCIENCES.

Mentioning first some of the less closely connected sciences, botany and forestry are involved to some extent in the selection, preparation and preservation of poles, cross-arms and pins, as well as in the more carefully finished woods used in switchboards, instruments and in buildings. Zoology or animal biology are involved in the care of the human and four-footed servants of the industry and in the destruction or other discouragement of objectionable forms of life which destroy either property or peace and comfort.

CHEMISTRY.

The science of chemistry enters the telephone field in several places. The telephone manufacturer is interested in the chemical composition and the possible chemical reactions of paints, lacquers and other preservative coatings for apparatus and other construction. The composition and performance of insulating material involves more or less of chemical knowledge and of chemical reactions. Chemical corrosion from the use of soldering salts and fluids may be troublesome to both the manufacturing and the operating branches of the industry. Electrolysis from foreign currents and from the much more common local action is of great importance both in its possible effects on the sheaths of cables and wherever else moisture may come in contact with the telephone circuit. The weathering of wires, insulations and poles is an important chemical effect. The electrolytic rectifiers sometimes used for obtaining direct current from alternating current supply depend upon chemical reactions. Primary cells, both dry cells such as used with transmitters or bells, and the wet cells sometimes used in small exchanges, are based on chemical laws. Secondary cells or storage batteries operate in accordance with known chemical laws, both in their normal operation and also in subsidiary actions such as the sulphating of the plates and the corrosion from the fumes. The prevention of trouble, especially by electrolysis and in the proper maintenance of secondary cells calls for a more or less detailed chemical knowledge. While many of the above mentioned chemical relations act in comparatively simple ways, a full understanding of their direct and indirect effects involves a general knowledge of the laws of chemistry.

GENERAL PHYSICS.

The general science of physics includes a number of fields of knowledge, each of which is involved in telephony. Most of the fields of engineering may be considered as developments or extensions of physics, usually of mathematical physics.

The laws of mechanics of materials and of its engineering extensions are involved wherever the strength of various parts is important, such as poles, lines, roof structures, and the various parts of moving machinery. They are involved in the operation of relay and annunciator armatures, of spring jacks, of ringers, of receiver or transmitter diaphragms, of time stamps and various other apparatus.

HEAT.

The laws of heat are vitally connected with daily life, in the maintenance of animal heat, in personal clothing, in heating of buildings, in the cooking of food, and less directly in various manufacturing processes, in the development of power, in the various sources of light, and in the manfold uses of the sun. Users of electricity have additional contact with the laws of heat, since a properly regulated current will maintain any desired temperature at any desired place. Excessive temperature must be guarded against by the proper proportioning of the size of conductors to the current they are liable to carry; additional safety is secured by proper construction and installation of fittings and other supports; fuses and heat coils provide additional protection by opening the circuit when the current exceeds safe limits. The heat developed by the current in electrical machinery and other apparatus is generally what limits the safe output. Heating effects limit the amount of safe current through a telephone transmitter, and thereby limit the distance over which telephone conversation may be conducted. Moderate degrees of temperature from electrical sources of heat are used in the soldering coppers of the construction and maintenance men in the exchanges; maintenance of proper temperature of soldering pots and ladles is of importance in cable work. Moderate temperatures are desired also in the various electrical cooking utensils which may be found in the welfare rooms or restaurants found in some of the more progressive exchanges. The temperature of the storage battery should be carefully guarded and watched, lest it rise too high, especially during charge; the temperature should not be allowed to fall too low, lest the output be reduced abnormally. Relatively high temperatures are utilized in the small incandescent lamps used as indicators on the switchboard and in the larger ones used for general illumination. High temperatures are required in the sparks of electrical ignition systems for gas or gasoline engines used for power in exchanges, or for motorcycles and automobiles. The contraction by cold is an element to be considered in determining the safe tension to be used in stringing wires on pole lines, lest wires strung in summer be subjected to excessive tension in cold weather. The change of resistance with temperature may make considerable variation in the apparent length of outside circuits, and this may introduce complications in determining the location of faults by electrical measurements. Consideration of these heat effects shows that even a small knowledge of the laws of development and conduction of heat is helpful to the user of a telephone, while a full appreciation of such laws is desirable to the telephone engineer.

LIGHT.

The laws of light have important applications in the use of visible signals, and in the illumination of the buildings, especially of the switchboards, shops and offices. This is of great importance, both for the comfort of the employes and for enhancing the accuracy of work at the switchboard and for improving both volume and accuracy of work in the offices. Good lighting not only makes better work possible, but its psychological effect induces more interest and higher efficiency.

SOUND.

The laws of sound have important applications in the exchange building, in the performance of telephone apparatus, in the accurate formation of speech sounds by the speaker, and their accurate reception and interpretation by the hearer. These laws also have important application in the theory of speech. Questions as to the equivalent pitch or frequency of speech involve the laws both of phonetics and of alternating currents. The shape of mouthpieces and earpieces, shape and size of cavities, use of soft cushions for ears, proper location of

lips with reference to mouthpieces, should be amenable to definite laws. Architectural acoustics are of importance in securing a quiet operating room, and are important in certain special applications of telephony, such as the acousticon for use in auditoriums.

MAGNETISM AND ELECTRICITY.

The laws of magnetism, as applying both to permanent magnets and to electro-magnets, are important in the construction and operation of telephone receivers, ringers, annunciators, relays, repeaters, and other forms of induction coils, generators, motors, and various miscellaneous uses of electro-magnets.

The laws of electricity apply to almost every phase of telephony, being applicable in various degrees from the most simple to the most complex. The laws governing direct currents have important applications in the construction and use of primary and secondary batteries, in the circuits for central energy systems, and in numerous cases in local energy systems.

ALTERNATING CURRENTS.

The laws of alternating currents apply in general to ringing and to talking circuits. They apply particularly to the performance of the receiver, retardation coils, repeating coils, to the use of phantom circuits, to the determination of the equivalent frequency of the telephone talking currents, to the loading of lines for increasing the limiting distance of speech, to the various uses of condensers and of distributed electrostatic capacity to the calculation of the equivalent resistance, impedance, or admittance of various electric circuits and to many minor phenomena.

MEASUREMENTS.

Electrical measurements of various kinds are essential to the proper handling of a telephone system, and are indispensable for many lines of investigation. Each measurement, whether approximate or refined, involves more or less theory, in both the design and construction of the instruments, and in their use. For most measurements of current, of voltage, and of resistance, the ordinary commercial instruments are suitable, and their use requires more or less knowledge of electrical theory.

Some mystery seems to surround the wire chief who can sit at his desk and after moving a few switches and watching some instruments can look at some tables or make a few passes with a slide rule and then confidently tell the lineman that he will find two circuits crossed between the fifth and sixth pole beyond Podunk Corners, and that another circuit is broken about a half mile further. Yet such decisions are of daily occurrence and the lineman is very likely to find the trouble close to the place indicated.

The great obstacle in the way of more definite knowledge of telephony has been that the speech currents to which the telephone receiver is sensitive are so exceedingly small that ordinary measuring instruments are of little if any value. It is not diffcult to measure currents between the limits of, say, one thousand amperes and one-thousandth of an ampere. But when it comes to telephone current of the order of one millionth of one ampere or of one million-millionth part of an ampere, very great difficulty is experienced. The measurement, or even the estimation of such exceedingly small currents involves both a broad knowledge of the theory of electrical measurement, and also a high degree of manipulative skill which can only follow a clear knowledge of the reasons for the various steps.

MATHEMATICS.

The various branches of mathematics have frequent applications to telephony. Mathematics is sometimes considered as a method of thinking, or as a kind of logic. It may be considered as a means of expressing thought more tersely than in words and as a short-cut to reaching conclusions. When properly understood and properly used, mathematics is a powerful tool which not only enables one to reach reliable conclusions more quickly and with less effort than by other processes of reasoning but also enables one to go further and reach conclusions difficult if not impossible to reach by other methods. An adequate acquaintance with mathematics helps one to analyze a problem into its elements; it helps one determine the limits within which any one of the various elements may be modified advantageously; it enables one to determine the conditions for greatest output or for greatest efficiency, or for greatest economy. Even in cases where one is unable to secure reliable numerical data and is, therefore, not able to introduce exact numerical quantities into the mathematical expressions, the general effect of the elements may be shown mathematically. Knowledge can hardly be called exact until we are able to say not only "how" and "why" but also "how much," and this almost invariably involves more or less use of mathematics.

VALUE OF TECHNICAL TRAINING.

These remarks have aimed to indicate a few of the ways in which theory is applicable to telephony. It is recognized that many of the developments in telephony have been made by men whose only theoretical knowledge came through experience in the School of Hard Knocks. It may be pointed out, however, that some of the greatest steps in advance have been made possible only as the result of applying the highest technical training and mathematical theory to the problem of telephony. It is difficult to imagine any process of reasoning from so-called "horse-sense," through which one would arrive at the general idea of loading telephone circuit to make possible longer distance transmission. It is confidently believed that the large future steps in the improvement of telephony will be made by men who combine both practical experience and theoretical knowledge. There is yet much that we do not know or perhaps even suspect. We may look forward to great advances in the future of telephony.

May Tax Advance Rentals

Telephone companies are liable to assessment on all money on hand on March 1, even if some of it is money that has been received in advance rentals, according to an opinion. The Indiana State Tax Commission asked the opinion at the request of the Lafayette Telephone Company of Lafayette.

Company officials had expressed an opinion that advance payments, because they were held in trust by the company until the service was rendered, were not subject to taxation, but the attorney-general holds that if the money is in its hands March 1 it is subject to regular taxation.

Although the telephone company has always paid taxes on this fund a doubt existed as to whether they should be required to do so and for the purpose of securing an official opinion George P. Haywood, attorney for the telephone company, put the question to the members of the tax commission and the commission submitted an opinion as set forth above.

Little Stories of Operating Activities

The Operating School at La Crosse, Wis., Described by W. F. Goodrich

The Operators' School at La Crosse, Wis. W. F. Goodrich of the La Crosse Telephone Company May Be Seen in the Center, With W. S. Vivian of the Independent Telephone Association Halfway to the Right.

EVERY telephone office handling long distance calls has rules by which the long distance calls are taken care of by the operators; but if the rules are not established by competent traffic experts they are the result of instructions from the connecting long distance company or they are "home made rules," which, in the light of modern operating, have no value, because, unless the minimum of time is consumed by such operators a loss results from the tieing up of valuable property during the time no revenue is accruing.

It is safe to assume that every office not having had expert assistance in the adoption of modern practices for handling long distance calls is consuming from 50 to 75 per cent too much time in the passing and recording of messages. There are many offices up to 5,000 telephones which have no toll line connections with comprehensive toll line companies, therefore the traffic regulations are neglected because the company cannot afford a competent traffic expert and because of inadequate circuits more lines are added for the business when no new lines were necessary if the operators were not using too much time needlessly in passing the calls.

THE OPERATOR'S REVERIE.

By Isabel Felise Elling, Toledo, Ohio.

The life of a telephone operator
Is one of trouble and blame;
She gets all the kicks and the cusses,
And the company gets all the fame.
So last night as she sat by the fire
And gazed at the holes in her socks,
To her mind came this pleasing reflection:
"My only reward is hard knocks."

Many men may qualify as traffic men not only in their own estimation, but in perfecting rules which will enable the operators to give a passable service, and in fact the public in a certain community seems satisfied because it is accustomed to it. The ideal custom would be a uniform method which the public would receive at all stations in an area surrounding any large center, and the public in that area would be accustomed to the same promptness and phrases from the operators when calling from the small town as from the operators in the city. If the toll center of a community of, say, 100 miles will assume the responsibility of conducting a

school for two days and arrange for the instructor, then the whole community gets the benefit of one expert traffic man at an expense almost negligible as compared with the benefits derived.

Operators, Owosso (Michigan) Exchange, Union Telephone Company.

The La Crosse Telephone Company arranged with W. S. Vivian, secretary of the Independent Telephone Association of America, for a two days' session on March 16 and 17, at which an average of forty chief and toll operators were instructed at four sessions. The meetings were held in the parlor of the Stoddard hotel, and chief and toll operators in the vicinity of La Crosse readily came and their companies paid their hotel and railroad expenses. Sessions were held at 9:30 a. m. and 2 p. m. on both days, and on Tuesday evening, the 16th, all were entertained at a theater party, and a lunch later, by the La Crosse Telephone Company. All visiting operators were registered at the hotel and the telephone company invited its own chief and toll operators to accompany the visiting operators at dinner and supper on both days so that city operators were always with the visiting operators while in La Crosse.

The "Traffic Department Operating Rules" were explained by Mr. Vivian and new interpretations of them given, so that they were thoroughly understood as to reasons why, and he held the attention of the operators constantly. The value of an efficient instructor was plainly evident and all were enthusiastic over the help and new ideas obtained. There had been practically no acquaintance between the city operators and connecting line operators and the personal acquaintances made will be helpful and lasting. The operators' school for this vicinity will probably be an annual event hereafter. It has been suggested that the Wisconsin State Telephone Association hold an additional summer convention, but the writer is of the opinion that it would be of infinitely more value to the public to hold a state operators' school with a competent instructor instead of a second convention, for it would result in better service everywhere.

Operators' School at Winona, Minn.

ACCOMPANYING this article is a picture of the operators who were present at the Operators' School which was held at Winona, Minn., on February 25 and 26. This school was held under the auspices of the Tri-State Telephone & Telegraph Company of St. Paul, Minn., and is one of a series which is being planned for the state. This was the third. Previously schools were held at Owatonna and at Mankato. These schools are being conducted by W. S. Vivian, secretary of the Independent Telephone Association of America. It is expected that the increased efficiency which is a result of getting the operators together in this way, so that they may have a better understanding of their work and of working conditions in the many offices, and the necessity for performing the various parts of their work in standard ways, justifies the necessary expense many times.

The Operators' School at Winona, Minn.

There can be no question but that if a standard method of operation as prescribed by the Independent Telephone Association of America is put into actual practice in every office and by every operator the efficiency of equipment, as well as operators, can be increased many fold.

Harmony

THAT "co-operation and harmony" is the watchword of the operators of the

Union Telephone Company at Owosso, Mich., can easily be verified by a visit to the well lighted and ventilated operating room which occupies quarters on the second floor of the telephone building. Every convenience and accommodation has been furnished, such as individual lockers for each operator, a well furnished rest room, sanitary drinking fountains, being on a par, and perhaps better than those of larger exchanges in greater cities. Experience meetings and conferences are held regularly, in which the management usually introduces some social feature, which have paid a handsome return on the investment in the way of satisfactory service. These meetings often solve vexing problems. As their exchange does not afford a regular attendant to care for the rest room, the question of how it was to be kept clean and in order was a problem which was solved by appointing a committee of three operators, who are assigned duties for a certain period. As each duty occupies but a few minutes it is not a hardship, and as the assignments are changed each week the rest room is always kept in a clean and satisfactory condition.

Miss Mary Thibeaut, Cadillac, Mich.

Sadie Parker, Monmouth, Ill.

Miss Margaret Bernhardt.

The last annual report of the Union Telephone Company shows the total income for the year $231,065.28. Of this amount $70,799.32 was for long distance receipts. The management displays a keen interest in the operation of its long distance business. In all exchanges where the monthly toll business is to the amount of fifty dollars, calculagraphs have been provided. The general manager is in daily receipt of a postal card indicating the condition of all toll circuits, tabulation of all delayed calls and the reasons therefor. The toll lines are regularly patroled. Appropriations are made each year for the re-building or the construction of new toll circuits. The management realizes that well maintained and constructed toll lines are productive of good long distance service. Thirty-six exchanges are operated. Connections are also made with many locally owned telephone plants.

Order and Discipline

By Mary Thibeaut.

I believe that order and discipline are both necessary to good service. Our operators are required to be in the building and ready to form in line two minutes before time to enter the operating room. The line is formed and the chief operator heads the line, followed by the supervisors, toll operator and local operators in the order of the positions assigned. On entering the operating room each girl secures her own operator's set from the rack and takes her place at the right of the girl on duty, she leaving her position to the left at the signal of the bell, given from the desk.

We have found this plan to be not only helpful in avoiding confusion and noise in the operating room, but it also helps the operators to be on time. We find our records of tardiness described by more than two-thirds since we adopted this plan.

(Miss Thibeaut was born in Plantaganet, Ontario, coming to Cadillac, Mich., with her parents when a child, and educated in the Cadillac public schools, started work for the Citizens Telephone Company as local operator in October, 1906; promoted to night chief operator in 1910 and later to supervisor. In June, 1914, she accepted the position of chief operator made vacant by the resignation of Miss Bessie Bottomley.

Her experience in the various lines of telephone work has fitted her for excellent service in the position of chief operator. She believes that order and discipline are both necessary to good service and is working out a plan with good success, which she gives us in this issue.)

My First Telephone Work

By Margaret Bernhardt.

THE Citizens Telephone Company, the first independent company in South Bend, Ind., was where I began, and I remained with them until they sold to the Bell.

Discipline was an unheard-of thing. In the morning we were quite busy, but in the afternoon we had nothing to do. The chief operator would allow us to have pencil and paper at the board—perhaps to keep us out of mischief. Each operator, in turn, would watch the board, while the rest of the operators would see how many words could be made out of a word,

not using the letters more times than they appeared in the word used. Imagine that in our offices today!

Our chairs were great high things. When I first saw them I thought they must use a step-ladder to reach the top, and the receivers were the kind used in phonograph galleries; drops that never restored, and buttons that always stuck; our trunking system, I am sure, never was intended to work, and if it did it was by accident.

We had two night girls that, from all the trouble reported, must have slept all the night. I don't know but I was one of the operators that did most of the sleeping.

We had no toll trouble in those days, for we had no toll lines to begin with, but finally we did connect with Plymouth, Ind., and some other place, I have forgotten where. We naturally thought it would be just a short time until we would be able to talk to New York.

The toll lines we did have were not like the toll lines of today. You talked as long as you wanted to, as there was no three-minute rate, and most of the time as loudly as possible—the louder the better.

Those were happy days, long to be remembered, and team-work existed within the four walls of the old Citizens Company, as we have proven by keeping together our little band of opposition girls.

We were getting on nicely when one day our manager had a little heart-to-heart chat with us, telling us that the company had run out of funds and they were going to sell to the Bell, which they finally did, so day by day our family ties were broken and we were transferred to the Bell.

However, we were independent at heart, and to show our colors we got together and organized a club, and called it the Opposition Club.

We have met every month since its organization, with the exception of July of each summer, when we have a picnic or an outing of some kind, and in the thirteen years of this "club's" life there has never been a misunderstanding; that feeling of good-fellowship and co-operation is ever alive, and when we get together it is like a family reunion.

We found the Bell operators were not any too kind with us; they tried to make us feel inferior, but after we had learned the Bell tricks they had nothing on us, as every operator transferred surely made good. We were determined to win, and we did. I was promoted to assistant chief and filled the position for two years, when I accepted a position with the A. T. & T. Co. as supervisor and was with them until five years ago, accepting at that time a position with the South Bend Home Telephone Company.

We have a splendid office, each operator taking great pride in her work. Our office is very progressive, always open for inspection, and solicits criticism, for oftentimes a visitor can detect a mistake that we couldn't, being in it every day.

Get the Operators Together

By Sadie Parker, Chief Operator, Monmouth, Ill.

ABOUT four years ago my telephone experience started. I worked on the local board for about six months, then as night operator for about the same length of time, when I was changed and made supervisor. I held that position for almost a year. Then I was made chief operator, which position I now hold. I have always found the work interesting, especially the toll work. It seems to give you a broader view of what telephone work really is and the value of it. I have also found that the work depends largely on the operator as to whether it will be a success or not. If she has a pleasant voice and a way to show you that she is interested in her work, and is going to do her best not only in just taking the call but in passing it through the different exchanges and making friends of the operators as she goes, success is sure to follow.

Co-operation is what there should be between all operators of different exchanges, and to bring about this result, I think it is a good plan to get the operators together occasionally and talk over the little difficulties that have been troubling both parties. I believe I can speak from experience, as we held an operators' school here in the fall, and also later held a district meeting for operators, and feel certain that I can trace good results from both meetings. I also believe that if each office would get a copy of the telephone rules and follow as closely as possible, learn the different codes, etc., valuable time would be saved. Our aim is to "give good service by allowing no poor service."

Minnesota to Get Universal Physical Connection

The Minette-Burrows telephone bill will undoubtedly become a law. This measure has been before the Minnesota legislature for fifteen years and was passed two years ago by both houses but failed in becoming a law through the veto of Governor Eberhart, although the House passed the bill over Eberhart's veto. The senate sustained the veto at that time and they kept the measure from becoming law in spite of the veto.

The most popular feature of the bill is the physical connection of competing lines on terms to be fixed by the State Railroad and Warehouse Commission, under whose jurisdiction telephone companies each are placed in this measure. Physical connection is required only of toll lines. It does not include local calls. Under the Minette-Burrows bill, a subscriber of the Northwestern Telephone Company of Minneapolis cannot get connection with subscriber of the Tri-State Company in the same city, as that is local call, but the Northwestern subscriber of Minneapolis can talk to Tri-State subscriber in St. Paul or any other place outside of Minneapolis, as that is a toll call. Governor Eberhart's reason for vetoing the measure two years ago was that he considered it a halfway measure. Mr. Eberhart is a firm believer in state control of all public utilities and he feared that the enactment of the Minette bill would delay the passage of a complete state control of public utilities.

Remain on Duty During Bombardment

During the bombardment of Scarborough the trunk telephonist and the night telephonist at the local exchange courageously stuck to their posts. Urgent military calls to Hornsea, York, etc., were effected before the wires were shot down and communication ceased.

The vibration caused by the bombardment shook down all the indicators on the switchboard. It seemed as if all the subscribers were calling at once.

All the staff who remained on duty during the bombardment of Scarborough, Whitby, and the Hartlepools have been specially commended.

European Telephone Development

Translations from the Foreign Press and Communications from European Engineers

BY FRED W. SCHOLZ

EUROPEAN telephone systems differ in detailed respects from our own American systems, some of which are expressed in painstaking differences in relations between the public telephone system and the private system. One of these points covers use of inter-office telephones, as we find in all manufacturing plants, office buildings and smaller or larger industrial works. Most of the telephone systems are in state hands, and the state has therefore created two types of systems in this respect: (1) The so-called "pure postal plants," *i. e.*, those telephone systems where all of the office telephones and departmental telephones are permitted connection with the public system, and (2) mixed plants, where there are branch telephones that have no right to connect to the public system. The "pure" plants comprise the trunk lines connecting the switchboard to the public telephone lines, (*b*) the inter-office telephones, installed either by private companies or by the telephone department and permitted to connect to the public system, (*c*) the outside state-owned telephones. For general information it may be here stated that the law books upon the idea of "estate" as consisting of an area of ground belonging to a corporation or private party, and not divided off by some public highway. Even if two estates lie on the opposite side of a public street and are joined by a bridge, the state looks upon these two as separate and the telephone plants used must be installed in keeping with the view of two separate estates.

In telephone plants provided with connections that are not permitted to connect to the public system, these telephones must be installed entirely separately from the public system. Connections are permitted only in so far that the state-owned telephones may communicate with these inter-office telephones, but the latter are not permitted to use the public telephone lines. We have then (*a*) the trunk lines; (*b*) the state-owned lines; (*c*) the office telephones, with public connection; (*d*) the private telephones without public connection.

Still more complicated is the system if the owner wishes to have telephones installed by private firms on other estates and to have these lines connected to the public trunk lines. He is entitled to this if the conditions do not meet objections on the part of the state department or if permission has been obtained to install these telephones. These private lines, as for example a private wire laid from the residence of the president of a corporation to his business offices, may connect with any of the private offices, but not to those having connections with the public wires, nor can he connect to the public trunk line. The owner has a further right. He may, if his business requires it, place a private telephone instrument in the office which contains the state-owned telephone, but must obtain a special switch from the government. The private telephone does not pay tolls, but must be housed in the same office or space with the state telephone set. No other telephone may be connected.

If a subscriber wishes to connect several telephones to one line, instead of connecting each telephone to the public trunk by a separate wire, creating a type of party line system, he may do so, provided he connects only two lines to one main trunk. Cross connections, *i. e.*, direct connections between two main switchboards, are not inter-office connections; are not added together as separate lines, when the inspectors inspect as to the number of inter-office lines permitted by law. Lines of this type installed by the owner himself are permissible, provided they are on the same estate and belong to the same owner. Private lines between different estates are permissible but may not connect to the public lines.

In regard to the connection between private lines with public wires, there are various detailed points that must be observed, especially in regard to controlling and testing instruments. Every trunk wire is connected to the upper two terminals of a switch, which serves as a control apparatus. Of the lower terminals, one goes off to one side to the state telephone, the other to the other side to the private switchboard. For each trunk line there is one of these switches, which is furnished by the state at the expense of the owner. This switch has the purpose of facilitating trouble testing in case of disturbances. If there is trouble in the line, the owner is asked to connect the line to the left side, *i. e.*, to direct connection with the state telephone. If the apparatus, on testing, gives good results, then the trouble lies not with the state lines, but within the private telephones, and the owner must have private firms repair the trouble. If the tests are not satisfactory, the state sends its repairmen to repair the trouble.

Of the inter-office plant the requirement is made that it shall give satisfaction in practice and shall be of the same standards as the public telephones. This is especially true of transmitters and receivers, which must be tested and shown to be of the same standards as the state instruments. The crank generators used for calling the office telephones as also the pole changers and calling generators must not have a voltage smaller than 30 volts and with no calls no voltage higher than 40 volts. As calling current generators, either converters (coupled or single armature), or transformers may be used. The latter are used extensively, when the public power system is alternating current. As this is usually 50 periods, step-down transforming is easy. When inspecting the plant, the government inspectors are to see that the secondary calling circuit is protected at both poles against two amperes current and that primary circuit is also safeguarded against accidents. With common battery circuits, the calling current is to be arranged so that the calling current cannot reach the head receiver of the exchange operator. In general, private lines must be guarded against contact and influence of high tension lines. The same is true of the low tension currents, which are more common now with electrical operation in so many plants. There must also be present a general switchboard and an intermediate distributing board. If necessary, a list of the various office exchanges must be furnished to the state department, and any changes or additions within the plant must be sent to the state department first, for approval. If an owner decides to have a private telephone system installed in his place of business, he has to submit the plans, diagrams and blue prints to the state telephone department, which will inspect them and pass it. The plant when finished is accepted on the basis of these plans,

and no changes may be made without the consent of the state inspectors.

On the technical side, the first requisite is a safeguarding of the trunk lines so that no calls may be made from offices to public lines that have no permission to that end. To guard the trunk lines from dishonest work, the so-called "protected" switches and connections are used, in which there are no connecting parts that appear from the outside, and have the form of keys which are pressed down to make connections and is released automatically, as soon as the call is ended. Such a protected set is shown in Fig. 1.

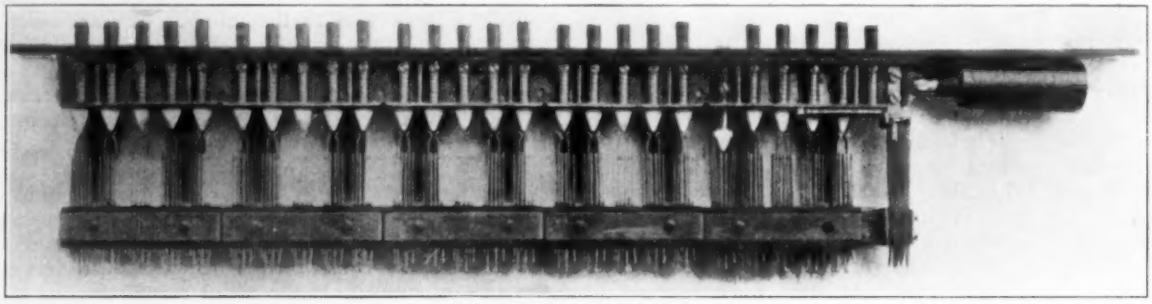


Fig. 1.—Protected Switch Set.

As for the connection of one exchange trunk line with one private set there was always the need for one key, a large number of keys would have to be used, where there were numerous trunks and private telephones. For example with one trunk and five exchanges, 1x5 keys would be needed for 2 trunks and 10 offices, 2x10 keys, and for 3 trunks and 15 offices, 45 keys. As this would make a very unwieldy arrangement, a so-called "traveling" pressure key device was used. For each trunk line there is one of these traveling sets. If trunk line 1 is to be connected with office 10, the operator moves the key along the grooved rail until it stops at 10. Here the key is pressed down, and is kept stationary automatically. Below this point is the spring set, whereby office 10 and trunk 1 are connected. In one form of office switchboard the traveling set is even simpler, since the key is not pressed down, but bent either upward or downward; upward, if the office exchange lies in the upper row, downward, if it is on the lower row. The rail is shortened by this fact and the path of the key is shortened. Fig. 2 shows a device which is often used to release these keys.

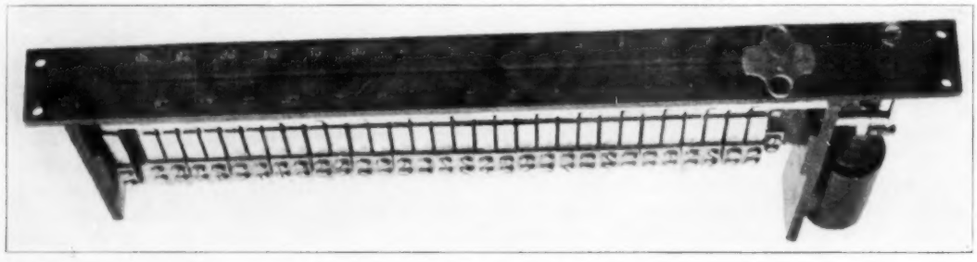


Fig. 2.—Release Device for Traveling Key.

As soon as the receiver is hung up at the end of a call, the current circuit breaker operates an electromagnet, which returns the key to its rest position.

Siemens and Halske use a plug key system in order to avoid the numerous buttons. The office exchanges on the switchboard have jacks, into which definite plugs, in the form of keys, as shown in Fig. 3 fit. The requirement, that illegal connections between offices and outside trunks be not made, is met by varying these keys, as would be done in ordinary door keys. The conductive parts of the trunk lines in the jack are protected by insulations lying in front of the conductors.

The key plug itself forms connection only indirectly, by compressing some spring sets, which are to be pressed together and form a connection in that way. In order to avoid the use of a special key for each connection trunk office, the following trick has been used. Every inter-office telephone has a jack of its own. On the other hand every trunk is connected by way of all of the jacks (the cross bars in Fig. 3). In addition there are as many key-plugs as there are trunks. These plugs have on each side a small projection like the ridges of a key, as Fig. 4 shows. As the same figure shows, these ridges are at various heights in each plug. If, for example, we insert plug 5 in jack of office, 1, and turn the plug, then the projecting pieces will compress the springs on the inside of the jack just at that place where trunk 5 is conducted over office jack 1. Both lines are therefore connected. The connection of the trunk with an office, not permitted to connect to the public trunk line, would not cause a connection, as the inside of the key would not compress the springs properly.

In case the state department feels that there is no danger of dishonest attempts at connections with public lines, these protected jacks need not be used, which, of course, reduces the cost of the plant. The same is true, if the equipment has been made foolproof without the use of the protected jack.

In the "Janus" type of construction, every trunk line possesses a switch or key to answer calls coming from the outside trunk lines. The other positions of this key are used to call the offices desired. In place of these switches, some firms use pressure buttons for each trunk, one for answering, the other for calling. Fig. 5 shows a form used by Mix and Genet, with four positions.

With this switch, which consists of two levers, which operate either in couples or independently, the following connections may be made. 1. If the left lever is brought to the right position, it carries along the right hand smaller

lever with round pointed end (answering position). As soon as the number is received: 2. The left lever is laid over to the left and the desired office is called, after the proper key has been pressed down, or the traveling key moved to the right place. The right lever with round head meanwhile remains in the first position. The left lever returns automatically to the third position. 3. The third position has this effect: In many cases the office wishes to know who is calling, before answering. The switchboard operator must therefore have a position where the calling subscriber on the public trunk can wait, still connected to the switchboard, while the switchboard itself is connected to the inter-office telephone desired. This waiting on the part of the caller means only that there must be no danger of premature disconnecting by the public telephone operator, during the time that the switchboard operator at the private plant speaks with the desired office. 4. If the office is willing to speak with the caller, the right lever is returned to the rest position, *i. e.*, to the left, and in this position both telephones may speak with each other. For easier operation, most of these switchboards in private offices have red and green lamps, the busy lamps being green, the clearing-out lamps red. In connections from offices to trunk lines, a device is used which allows the switchboard operator in the main office to know whether connection with the trunk or with another inter-office is required. Each office telephone has two call signals at the main office switchboard, one red for trunk calls, one white for inter-office calls. The instrument of the offices has also two keys, one marked "trunk," one "office." Depending on which one is pressed, either the red or the white lamp shines at the switchboard.

Where permission is given to use the open jacks, the cost of the plant is decreased considerably. Here protection against illegal connection between offices and trunk lines is given by cut-off relays, which cut off connection in case an office tries to connect with a trunk to which it has no right. Often in such plants the connection between trunk and offices is with one-wire cords, while connection between offices is by two-wire cords.

Pure postal plants, in which there are no offices that are not permitted to connect to public trunk lines, are usually found in hotels. Here the installation is very simple, as there need be no protective devices to prevent errors. The cords are so connected that they may be used for connection between trunk and offices and also between offices. In very large industrial plants, there is often the desire to have connection so that the directors or managers may speak without fear of eavesdropping, and on the other hand, may listen to the conversations of employes without the latter knowing it. Such offices are connected in series with the main office switchboard. If this office wishes to speak with the trunk line, it simply connects directly. On the other hand calls from the trunk come in by way of the main office switchboard. The main office is usually called by this special office by simple removal of the receiver from the hook.—*Telegr. u. Fernsprech Technik.*

PRACTICAL MICROPHONE INVESTIGATIONS.

Investigations as to the value of microphone efficiency are in most cases very subjective. Two microphones, objectively exactly alike, are judged by two different people in an entirely different way. Practice in speaking, sense of hearing, have a great influence. In actual operation there are several other factors that are also of influence, as for example the individuality of the users of the telephones, the nature of the wires, and surroundings at the instrument. It is therefore very hard to judge a telephone microphone right. This is especially true if we wish to test new telephone microphones and compare them with the old standard common battery sets. To find a common battery microphone whose capacity is equal to that of a local battery microphone is very hard, for the efficiency of the microphone is the greater, the greater the fraction of total resistance the change of resistance in the microphone causes. In the local battery instrument the difference in resistance is about 35 per cent, in the common battery system this is about 20 per cent, a ratio which varies with the resistance of the current in the feed circuit and decreases with the increase of the latter.

All practical comparative tests try to obtain as great a similarity in conditions as possible. In these tests we have to watch for production of sounds, for reception of the sounds reproduced in the receiver, and the measurements of the difference. The most perfect case would be the mechanical reproduction of speech, and the transformation of its characteristics into curves, as for example with the oscillograph. The mechanical production of sound, as for example with the buzzer, has the disadvantage that only one type of tone is produced, and that there are no conclusions as to the spoken words. It is very

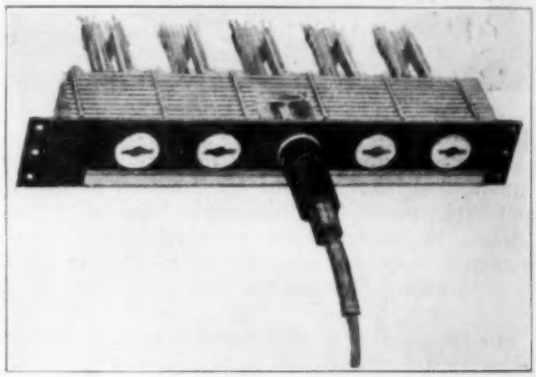


Fig. 3.—Protected Trunk Sets.

likely possible that the buzzer sound in question accidentally is reinforced by vibrations corresponding to it in the microphone, and that such vibrations would be lacking in the spoken word. The use of a phonograph, that has also been tried, has the disadvantage that the repeated use of the same record causes changes in the quality of the sound produced, which when using the same repeated sentence (and this is the only condition that could be employed), would give invalid conclusions. The use of the oscillograph is also out of the question, as it requires considerable amounts of energy, which prevent good working results. Longer tests would cause heating of the loops and corresponding changes, and photographic representation of spoken sounds is at best still an uncertain procedure which would not allow us to form very definite conclusions. The best means of comparison for practical methods are therefore human organs of speech and hearing, liberated as much as possible from sources of error. The speaker should therefore be as still as possible during the test, as movement of the body causes changes in the volume and quality of the sound produced and does not give as clearly enunciated sounds as is desirable for the tests. Nor should the person making the tests know what

is going on at the other end of the line, as mental energy influences the volume of sound. Whether it is better to say repeated sentences, or to read connected chapters, where sentences do not repeat is a matter of doubt. The tests as conducted here read successive chapters from a book, and have given good results. This has the advantage that the same sounds are not repeated too often, and

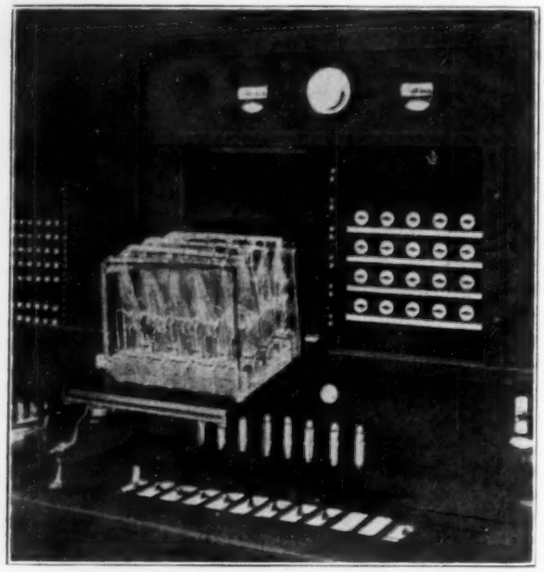


Fig. 4.—Outside View of Key Plug Switchboard.

that on the other hand sufficient variety of sound is given to find out any faults in the construction of the microphones. The quality of the sense of hearing by the person doing the investigations is not of great influence in comparative tests, nor does the receiver have much influence, provided the same receiver is used for all of the tests.

The measurement of difference in tone is made in shape of the amount of current connected or disconnected, in order to make the effect of the standard microphone and that one to be tested alike. There are two possibilities: Either with a low effectiveness of the testing microphone, one connects current in front of the microphone to be tested in order to weaken its own effect, or else if the standard microphone is too strong, one connects resistances in front of the standard microphone. The other method, and the better one, is to connect more current or to disconnect current conductors from the standard microphone, as the case may require. The latter method is the better, as in it the standard microphone remains the same, and the tested microphone is changed, so as to equal the microphone which is used as standard. The standard microphone, always having the same tone, will impress its sound on the ear of the investigator, and the latter will be better able to differentiate between the microphone tested and his standard instrument. The relation between tested microphone and standard microphone can then be expressed by the damping exponent β, which corresponds to the conductors, whose connection $+\beta$ or disconnecting $-\beta$ balances the differences between the two instruments. As the magnitude of the resistances and the resistance variations is important for common battery microphones, these ought to be recorded as well.

The following tests have been used for two years with good success and are based on the principles mentioned above: The tested and standard microphones are spoken into through a common forked transmitter mouthpiece. The plates used to hold the microphones are of brass. The speaker need not make a movement to speak into either microphone, as pressure on a button changes the one to the other. In all cases of testing variable resistances can be used, so that the substitution method can be employed. In order to test the microphones for any type of line, in other words for practical operation, a separate wiring system is used for the tests, as shown in Figs. 6 and 7.

As the connection of lines to the standard microphone differs, depending on whether one or two wires are used for the test microphones, two push buttons are provided for in the test instrument, so that either system may be used. When using the common battery system, the ammeter lies permanently in the battery circuit, since here the resistance of the measuring instrument as against the total resistance of the total circuit can be disregarded. In the local battery operation, the resistance of the measuring instrument would influence the total resistance of the local circuit considerably. The ammeter is then connected temporarily into the circuit, for measuring purposes only. In all these systems, the microphone can be replaced by a variable resistance.

Returning to Figs. 8 and 9, we may say this: The common central set of conductors is dependent on the construction of the system tested; two separate wires might be used just as well. The lamps, which are operated by the relays, worked by the push buttons, give the speaker the signal for changing in such cases, where instruments are tested, that cannot be connected to the system here provided. Such would be the case in permanently fixed microphones in wall sets and in solid back microphones. Here, of course, it cannot be avoided that the speaker changes his position to make the tests. These artificial lines are to replace the telephone lines. The constant line lying before the microphone belongs to one and then to the other microphone and is then in turn replaced by the artificial lines *1* and *2*, with whose aid the

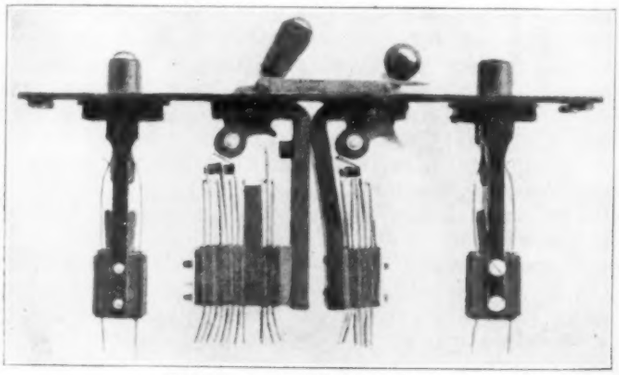


Fig. 5.—Four-Position Trunk Key.

comparisons are made. When using two lines (Fig. 8), these two artificial lines (*1* and *2*), form a part of the conductor to the push buttons, while in using one line (Fig. 9), these are switched alternately by the push button switch in front of the constant artificial line.

The method in testing is as follows: The two microphones are spoken into through the common transmitter. The variable resistance—in the local battery system, also the ammeter—is cut off. The regular telephone connection shows this peculiarity only, that both battery con-

ductors pass over the springs of the cut-off relays, which are worked by lock springs *I* and *II*. In the rest position all of the battery connections are broken. If key *I* is pressed, the battery is short circuited by relay *1*, microphone *1* is connected to the circuit, and to the telephone line, and the artificial line *1* is connected with the constant artificial line and the receiver. The relay of the second circuit is not connected and the feed current line of microphone *2* is interrupted. If key *II* is pressed down, key *I* springs back into position, relay *1* is cut off and through relay *2* microphone *2* is now connected by way of the artificial line *2* and the constant artificial line to the standard receiver. It may be noted that the induction coil 1:200 in the local battery circuit *II*, can be exchanged for other coils, in those cases where different telephone lines are to be compared.

When testing with one line only (Fig. 9), which is most reliable and most often employed, only one special relay is needed, through which one or the other microphone feed current is interrupted. The set of keys which operates this relay, at the same time connects the corresponding artificial line *1* or *2*. If the black key *I* is pressed down, the line to microphone *1* is connected by relay, and that to microphone *2* is interrupted, so that microphone *1* is connected. The telephone currents pass over the telephone lines, the key *I*, the artificial line *1*, connected by the key, and the constant artificial line to the receiver. The artificial line *2* in both the going and return circuit is interrupted by key *I*. If key *II* is pressed down, the key *I* is released, and the relay circuit is interrupted. The armature of the relay falling away, the connection to microphone *1* is broken, and that to microphone *2* connected. At the same time the connections to the artificial line *1* are broken, and the artificial line *2*, belonging to microphone *2* is connected with the receiver.

The speaker acts similarly with both systems. He connects the standard microphone to his receiver and gets his ear accustomed to the tone of voice used and received in the receiving instrument. It is best at this point to connect enough artificial conductors, so as to pass to the limit of audible conversation, because the deviation of even small amounts from this limit is easier to determine, than with the use of a low artificial line. The amount of power necessary for the test must be distributed over the constant artificial line and the artificial line *1*. For example if the constant artificial line were given a damping factor equal to $\beta=3$, then there would be given to artificial line *1* a similar quantity of $\beta=2$. The artificial line belonging to the standard microphone (*2*) must then be brought to the point $\beta=2$, being careful to see that this amount is the same for both lines. To keep the variable artificial lines on a lower initial, damping exponent is not advisable, as line *2* must offer the possibility of varying both upward or downward. Now the test microphone is connected to his instrument, which may be done in the middle of a sentence, and listened to for some time. If the quality of sound is poorer than with the standard instrument, he decreases the quantity of artificial line (*2*) leading to the test microphone; if it is greater, he increases it. Through frequent changing of the line *2*, the quality of the microphone is varied, until both give exactly the same sound. The value on line *2* taken in comparison with the constant value of line *1* gives the degree of superiority of the test microphone, and the values disconnected give the inferiority in terms of β. If the two microphones operate alike, the resistance and resistance variations are measured during speaking by noting the greatest and the smallest position on the ammeter, and afterwards replacing the microphone by the variable resistance, reproducing the current conditions corresponding to these positions of the ammeter. In order to avoid errors, it is advisable to have the same microphone tested by two persons at the same time, connecting them in parallel.—*Telegraphen u. Fernsprechtech.*

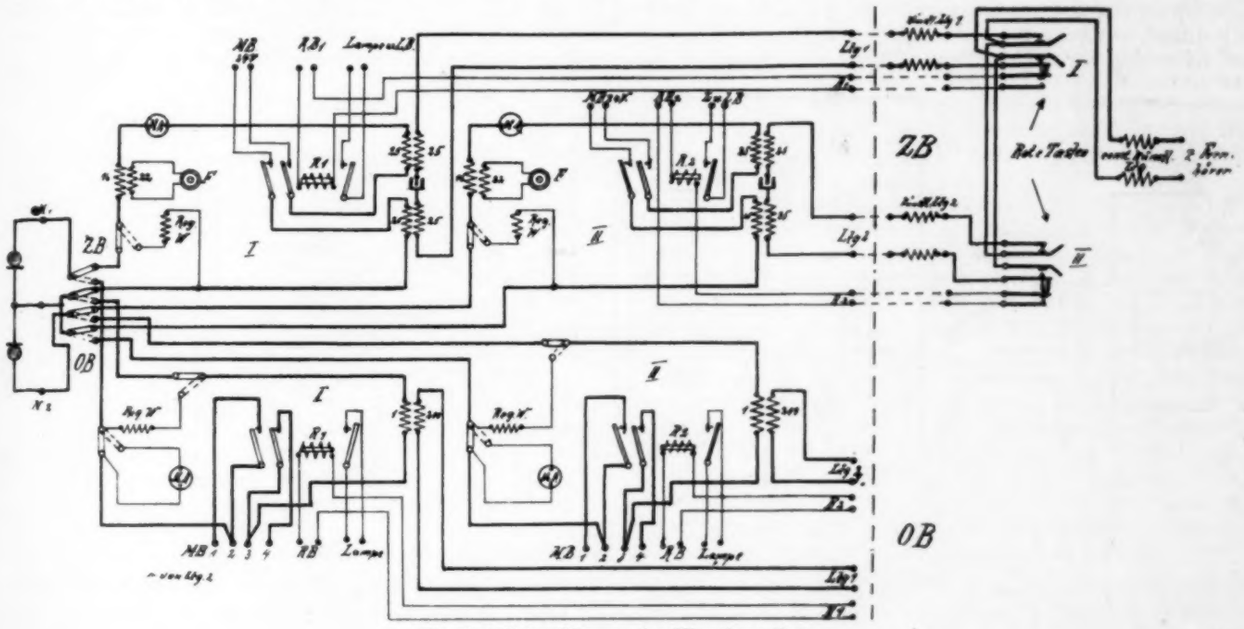


Fig. 6.—Wiring Diagrams for Microphone Tests.

VIENNA TELEPHONE SYSTEM.

Vienna began reconstructing its telephone system last year and expects to have it finished in its new form by the end of 1916. The old system was manual operation, and the Viennese department of telephones is going at the

change to the automatic system gradually by introducing the semi-automatic system to a limited extent and thus training the public in a partial use of the semi-automatic system, so as to have it able to use the full automatic system when that is installed two years hence. The only object that was made by some of the members of the board was the ignorance of the public to the use of the automatic system. These objections were overcome though by pointing to the city of Crakow, where the public papers carried on an energetic campaign to have the automatic system installed, when the question of reconstructing the old style plant came up for discussion. The automatic system in that city has worked to fullest satisfaction. It was decided, however, in Vienna, in order to be on the safe side not to install the automatic system immediately, but first use the semi-automatic system, where operators are still used to a limited extent. At the same time, the public is being trained to do without their services to some extent, and the next step to do without the operators altogether will then be much easier and will give less trouble in service. Meanwhile the Vienna plant is being built up on the automatic system and a policy has been introduced, whereby the subscribers are given the privilege of asking for replacement of their old apparatus by the new automatic sets as soon as they feel that they have enough confidence in themselves to use the new system without difficulties.

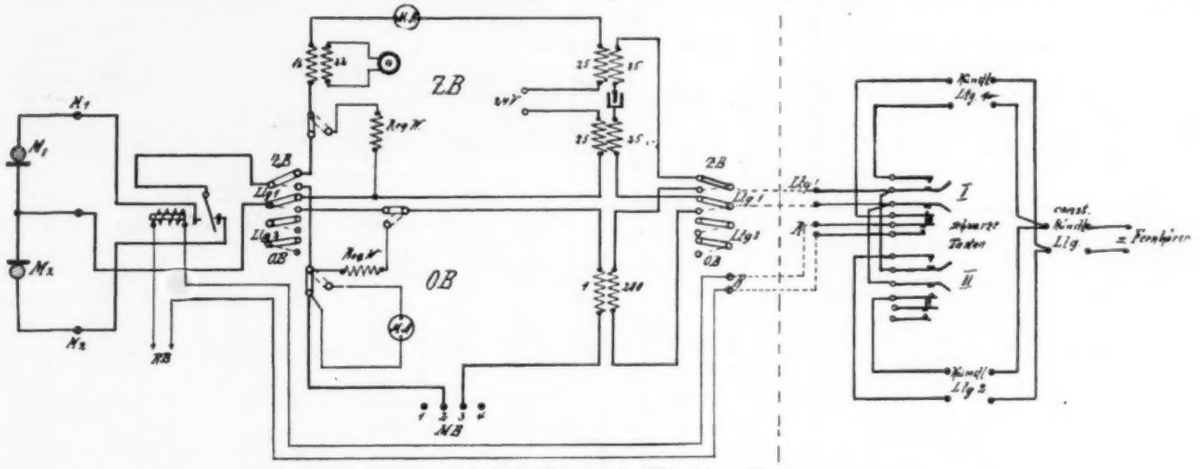


Fig. 7.—Wiring Diagrams for Microphone Tests.

The new system to be used is the one known as the "Dietl" system. The details of that system were subjected to endurance tests at the factory, which were equivalent to actual operation lasting 30 years and have stood these tests well. At the present time Vienna is the fourth largest telephone center of the continent, having a total of 58,000 telephones. In proportion to its inhabitants, Vienna does not stand so far behind, having one telephone for every 38 inhabitants, while London has only one telephone per 32 and Paris one per 33. The city that outranks all of these is Berlin with one set per 13 inhabitants.

As regards the equipment itself, Berlin stands in the first rank, having as modern a system and as large a reserve capital for its expansion, as any city of Europe. The system of London is antiquated except in spots; Paris is fairly modern. The Vienna system has been true to Austrian principles, namely going slowly, and feeling its way cautiously before starting an innovation or expanding. The new plant is built to take care of 100,000 subscribers, which will probably be sufficient for the next five decades or more, as Vienna is one of those cities which does not grow very rapidly, but rather slowly. Through later extension of telephone lines, increase of exchanges, and adding the fourth group selector, so as to bring the digits up to six, the plant will permit increasing to the million system, if necessary. The greater part of the work is done at this time. In several of the business districts 100 per cent of the work is completed. The extent of the work may be seen, when hearing that during 1914 and the preceding year, 210 miles of cable were laid with 40,000 conductors, that 6,200 roof poles for wires were put up and 3,000 miles of bronze wire were connected. The underground conduits 50 miles in length, surrounding the business center of the city are finished, having space for 2,500 cable conductors, of which more than half have been placed. About half of the automatic exchanges are being used at the present time, and the rest will be in use within this year and by the middle of the following year.—*Zeit. f. Post u. Teleger.*

State Telephone in Italy—In 1907 the Italian government bought up the telephone systems in Italy. Several small companies were permitted to carry on operation for another ten years, and in 1913 the government extended this privilege ten more years. At the present time there are ten private companies operating in Italy with state consent. The state owns 70 telephone systems and operates the most important long distance lines. Of these state systems that of Milan is the largest with 11,000 subscribers. Here common battery systems are used, one system installed by an American firm, the other by a German firm. The state system at Rome has 10,000 subscribers, that at Geneva, 6,000. The total number of subscribers of systems owned by the state is about 52,000; that of private corporations operating under state grant, 24,000.

London—It is stated that the central telegraph station and telephone exchange is surrounded by a cordon of soldiers, and that the windows and walls are protected against possible bombs by wire screens. It is not known whether the roof is also protected similarly against aerial bombs.

Argentine—Rosario, Argentine Republic, is installing an automatic exchange for 5,000 subscribers. A similar exchange in Cordoba for 2,000 subscribers has been working for years to complete satisfaction.

Physical Connection

Address Before the Independent Association's Convention at Minneapolis

BY HON. FRANK WINTERS

Mr. Winter's address as printed here is as he delivered it at the second annual convention of the Independent Telephone Association at Minneapolis. It is a condensation in less technical and more readable form of the long paper he prepared for the occasion and then abandoned in favor of the shorter talk, and is, in the opinion of the editors of TELEPHONE ENGINEER, *more valuable because of its more terse and vigorous style. We commend this version of the treatise particularly for its easily grasped applications of common sense, to say nothing of its legal sense.*

WITH the increased complexity of modern life have come new and serious problems. One of these problems and by no means the smallest and easiest solved, is the problem of the orderly development and growth of public utilities and their relation to the public they are created to serve.

The three most important classes of public utilities are railway and transportation, heat, light and power, and telephone and telegraph.

Railways were first built to serve comparatively small communities or localities. Many single railways served each its isolated area. It was soon seen that this arrangement was not satisfactory. Separate lines first made connections, then joined or consolidated, creating railway systems.

I speak of this because there is a remarkable parallelism between the development of the telephone companies and the railway companies. None of the laws governing the development and controlling the development of the railroad companies is fixed. In principle the laws should be the same, in principle the problems are the same, and in principle the same class of laws can be passed controlling and regulating the telephone systems. Now, you know, of course, without my speaking of how the telephone system grew up, how each individual center at the expiration of the Bell patents had its independent company generally; how these independent companies connected themselves with each other into little systems and larger systems into still larger systems. Now the problem is how to co-ordinate these systems into an intelligent whole.

It is perfectly clear, it seems to me, that vocal messages of communication should be made immediate and universal, that is, covering the whole region, and in order to do that there must be some kind of physical connection between the different telephone systems. There must not be simply a physical connection in a locality, but a universal physical connection such as we have today between the railroads of the country. The problem is to get that inter-communication, to get that co-ordination of lines without destroying the vitality of the little individual units, and without ruining and destroying the capital invested in each of those individual units. The problem would be easy if the facts were similar to the railroad problem, but there is one great, almost universal, company stepping in here—the Bell—claiming the right to monopolize the whole business; first in the field on account of its patents, and now claiming supremacy over all and refusing, in many cases, to connect itself into any universal system that it does not absolutely dominate.

Now, the problems that are before us legally and are before the independent companies, are the problems that were before the railroad companies, of how to make an adequate connection without the consolidation method of the railroads. That is one of them.

The principles governing the consolidation of these public utilities are essentially the same in fundamentals as the principles governing the consolidation and control of railroad companies. What are those principles? One of them was declared, and declared for all time in this country, by Chief Justice Wait in the decision of Munn vs. People of Illinois, which is this: that when a business has grown to such an extent that it affects the public generally, when its property affects the public interests generally, it becomes what we lawyers call affected with a public interest. When it is affected with a public interest the public has a right to control and regulate that utility or that business.

The railroad business long years ago, from its similarity to the general carrying business that existed before was declared a public utility, a public business, and the governments undertook and have regulated it. They regulated it by the police power.

Now, what is the police power? I took issue with our railroad commission in the case that I had. They placed the right to make a physical connection upon what we call the right of eminent domain. When you take property by the right of eminent domain you must pay for it. You cannot interfere with a man's property of any kind or take it under the right of eminent domain without paying for it. But in the exercise of the police power, which is the inherent power of government to control for the public welfare every business and the activities of men, the government can control the practices and even the rates of public utilities without making compensation. That is a very important thing; and the court conceded that that was the power under which the commission acted when it compelled a physical connection at La Crosse. In other words, it was not a taking of their property, but it was the exercise of a legitimate police power by which those corporations were regulated. It was the right of the community to insist that those corporations have a physical connection, that thereby the community might be benefited. It was not for the benefit of the independent corporations or the independent telephone companies that this order was made; it was for the benefit of the public. And the state exercising its police power compelled that physical connection.

You have before the legislature of this state (Minnesota—the Minette bill) a bill requiring physical connection; a bill, in my opinion, most excellently drawn. It requires a good many other things. It is House bill No. 21. In my opinion it should be passed. It should be passed, first, for the reason that it benefits the public; and, second, because it is, in my judgment, the only way that the Bell company can be controlled in its practices and independents be kept in the condition of being able to compete. Now, that bill requires a physical connection, as did our bill in Wisconsin. I think it is preferable to ours in some respects because it is clearer. That bill in one section requires a physical connection of all telephone exchanges and lines and gives the commission

power to compel that by order when the companies do not agree upon the terms and agree upon such physical connection. A hearing is had. If it is of interest to the public, if the public will be benefited, that physical connection is ordered.

This bill, in my judgment, will be declared constitutional. You independent fellows have been afraid of your own bills. I have been told repeatedly by independent telephone men that they do not believe the constitutionality of the Wisconsin statute will be sustained. Why, of course it is going to be sustained. In substance it has been sustained by the United States supreme court in half a dozen cases. It was sustained in the great case which came up in this state of Wisconsin & Minnesota, etc., Ry. Co. vs. Jacobson. A law essentially the same as this law was passed requiring railroads to make physical connection of lines and agree upon rates. I can cite you a decision in the supreme court of the United States which declares, for instance, that the A. T. & T. Co. is a common carrier of messages. That brings it under the same law that applies to common carriers of other things, that applies to railroads.

In the Minnesota railroad statute, which the proposed Minnesota bill follows, and which for that reason will be declared constitutional, it is provided that the commission may order physical connection of railroads. The commission ordered physical connection not simply of railroads that did not compete, but of competing railroads; and the railroads said, "Why, we are going to lose business; it is unconstitutional; it is a taking of our property; it is a wrongful exercise of the police power of the government; it is contrary to the constitution of the state of Minnesota and contrary to the federal constitution." But the supreme court of this state and then the supreme court of the United States in that case decided that it was constitutional.

The railroad commission of North Carolina ordered two railroads which did not make connections, to make connection at a junction point. The railroads said, "That will cost us more money than the freight and passenger traffic is worth; it is illegal, it is unconstitutional, it takes from us the right to manage our own property." And the supreme court of the United States said, "You have got to make that connection. The government, the people and their police power have the right to insist that you make that connection for the benefit of the public." The railroads said, "The commission has found that it will cost us $40 a day to run that thing, and we are earning only $25 a day." The court said, "That does not matter. It is the right of the state, it is the right of the nation to see that that connection shall be made for the convenience of the nation. You are a public service corporation, and that is part of your duty to make that connection." They made it, and it holds.

The other day—I say the other day because it is in the last volume of the supreme court reports—a railroad in Iowa said, "We will not take the coal cars of other railroads coming in from Illinois without unloading every pound of coal onto our own cars. We have a right to have our cars used. You have no right to take our cars from us in that way." But the supreme court of the United States said in that case: "That is a legitimate exercise of the police power. The Iowa commission has a right to compel you to take these cars and carry them; you have got to do it and do it without any arbitrary demands, too." Our Wisconsin law has been in principle sustained and, in my judgment, your law will be sustained.

Now, what occurred at La Crosse? The conditions were simply intolerable there. We had two competing telephone systems. The Bell system had somewhat the larger number of toll lines. The independent, the La Crosse Telephone Company, had by far the larger number of subscribers, over twice as many. The Bell company had (I am giving it from recollection) about one thousand four hundred subscribers to the La Crosse's thirty-seven or thirty-eight hundred when I made this application. The La Crosse company now has over 5,000 subscribers and the other company about 1,000. The La Crosse company pays good dividends, besides laying aside money for depreciation; the Bell company had a deficit when I began this litigation of $12,000 a year. In other words, it is allowed, and I don't think it should be allowed, to recoup its losses at La Crosse by taxing additional rates in Milwaukee and Madison and other towns which it controls. It is an illegitimate method of competition. The law was passed in 1911. No one had been called on to enforce it. I had had practice before the commission as chairman of a committee to fight an increase of $30,000 a year on our light rates. I had fought a case for the public, and some one asked me to make this petition. I supposed it was a mere matter of form and made it; but when I got the answer I knew it was no matter of form for I found attached to the answer the names of the ablest corporation attorneys in the state and two of the ablest corporation attorneys in the United States, the general counsel of the Bell company. I knew it was going to be a fight, but I could not afford to get out. I was like the man that had hold of the bear's tail. I could not let go without their saying I was either scared, bought out or did not have the ability to meet this matter. I had met such men in other cases, and I stayed in this. I think there were three hearings at least. We then submitted arguments. Extensive printed briefs were submitted by the attorneys on the other side and I, who was paying the fiddler, submitted my typewritten briefs as long as theirs. We fought it out with brief after brief. As far as I was concerned, I never got a dollar out of it. I had a supplementary brief submitted to me by the able attorneys on the other side about every third week. It seems to me they wanted to earn their money. At last the commission made a decision and ordered a physical connection. When the decision was announced I made an application that they be ordered to make it immediately and that the rates be fixed. And we had more hearings about rates. Finally they made an order fixing rates which I believe to be extravagant, unjust and wrong. However, they said the rate was simply temporary, to try it out. They ordered physical connection with five cents to be paid additional on each message within 50 miles, ten cents on each message up to 100 miles, and fifteen cents on each message above that, to be paid to the Bell, if, for instance, I, on my independent telephone, called up anybody over the Bell. On the other hand, the independent company gets the same rates on incoming messages. I do not believe, for reasons that I will give you, that any differential should be allowed in this matter.

The Bell company took an appeal from the order requiring physical connection by bringing suit against the railroad commission, against me and against the La Crosse Telephone Company, ordering us to desist from our nefarious practices of attempting to accommodate the public. That case, after argument, came to a hearing,

and then came a most extraordinary thing. I received a stipulation from the attorney-general and the Bell company providing that that case should be dismissed and we would get what we wanted at La Crosse. Now the case had been argued and submitted, the work had been done. I agreed over the telephone to do it. Then it occurred to me—that is just the thing that I would do if I was in the other fellow's place! I would put this thing all into the waste basket and be able to begin again the fight against Janesville and Superior whenever they wanted physical connection. I would not let it go to the issue; I would get up to the last step, then I would not step that step. So I said to myself, that won't do. I called up at my own expense to say that I would not agree to it. They filed their stipulation and asked that the case be dismissed. As a defendant in that case, I objected to its dismissal and moved for judgment. After a hearing the court refused to dismiss and it went to a decision.

Most of you are familiar with the order and decree in the Oregon case, in the district court of Oregon, the United States vs. the Bell telephone lines, the A. T. & T., etc. The decree which was entered does not provide for any differential. It provides that they must give the same service to one company as the other.

Now you people are scared, and unduly scared, in my judgment. Let us see what the supreme court of the United States has declared. Years ago a railroad company owned a stage line which we will call stage line A. Some other member of the public owned another stage line called stage line B. Both connected with a depot town. The railroads said to stage route B, "Since we don't own anything of your stage line, and since we own and control stage line A, we won't accept any passenger that comes from stage line B." They did not put an arbitrary on it; they put on the absolute veto that they would no longer accept any man coming over that line. They found that proposition lasted about as long as an icicle would in the infernal regions when it got to the supreme court. The supreme court said, "You railroad company are a common carrier. It is true you own this stage line A, but you have no right to discriminate between the right of the public to use stage line A and B. You must receive them alike."

Years ago the Bell company made an arrangement and contract (most of you know about that) with the Western Union Telegraph Company by which it disabled itself from giving like facilities to any other company. A telephone company, I think it was, went into court and said, "The Western Union refuses to give us the same connection that it gives to the Bell. It is a common carrier. It has got to give us the same advantage." And the court so held.

Let us see what the position is that one common carrier can exact a larger rate from a message coming over a line that it is not allied with. There are two routes of railroad from La Crosse, Wisconsin, to Minneapolis; the Burlington, which comes from La Crosse, owns the Great Northern railroad. Mr. Goodrich, for instance, comes over the Burlington and I come over the Milwaukee. When we reach here and want to go west on the Great Northern, the Great Northern says to us, "Mr. Winter, you didn't come over our line, the Burlington, and we have a right to fix an arbitrary rate on you for using our line, the Great Northern." How long do you think that thing would last in the courts anywhere? The A. T. & T. is a common carrier of messages, just as the Burlington road is a common carrier of passengers and freight. It has no legal right, in my judgment, to discriminate between a message from me, as a member of the public, which is sent over the La Crosse telephone line, for instance, and one sent over the Bell line; not a bit. It has got to treat all corporations alike; it has got to treat all members of the public alike; and that decision out west is based upon that basic principle. And you are making a mistake if you enter into any other contract.

Now you understand what I am speaking from. I am speaking from the standpoint of the public. I hold no brief from the independents. You don't own me. You pay me nothing. You don't owe me anything, nor do I owe you anything for this litigation. I am fighting because I am one of the public. And as one of the public I read with a lot of interest the letter of Mr. Kingsbury and the first contract. I wondered where in thunder the public came in. Ten cents on every out-going message over a reasonable charge—the supposition is they are charging a reasonable rate. Ten cents I must pay to the La Crosse Telephone Company, Mr. Goodrich's company, for originating business for this company, besides the ordinary full toll which covers the actual expense. Ten cents if I went down to my farm and undertook to telephone over the Bell line. That was one of the troubles with me; I have a farm and I could not reach it. They would tell me to go somewhere and find another telephone; and I would have to wander out in the rain and the storm to telephone to my own farm, when I could do it right from my dining room. I didn't stand that kind of stuff any longer than I had to. Now, what right had the company to say that the ten cents arbitrary over and above the actual value of the service should be charged to me, one of the public?

I understand now they have a modified form of contract. As a member of the public, it looks to me a good deal as though they had offered you a division of the swag. It does not look to me as if they had given anything to the public. It looks to me as if they wanted you to forget, as they have forgotten for a generation, that they are public services and that you are public servants. What right have you as controllers of utility to ask any person more than what the service is worth? What right have you to fix an arbitrary by contract or any other way? You are going to be put up against it pretty soon and it is wise for every one of the telephone utilities to face the facts. You have got to give complete, universal, cheap and immediate service at reasonable rates or the public is going to go into business of telephone ownership. It will not necessarily go into the business of buying your lines out any more than it did when it went into the business of carrying parcels. It did not regard the interests of the express companies; it regarded the interest of the public and the public alone.

I am not in favor of it, but I could give the arguments on which the government is ready to take possession of the telephone business. The postmaster general wants to take possession of this business and believes the government should assume it. You can prevent that, in my judgment, only by giving cheap and universal service. What should you do? You should come in and favor contracts like that. Now I do not know whose feet I am stepping on. I simply represent myself and the public interests, it seems to me. You should not undertake to make such a contract; and if I were the attorney-general to whom you presented it—and I do not believe that Mr. McReynolds is different—you would not get it through because it utterly ignores the interest of the public in

the controversy. Physical connection should be practically on the basis of the decree out west. You ought to face this thing right and straight as the owners and controllers of public utilities. The public has a right to efficient, universal and immediate service. It has the same right to joint rates and universal service that it has with the railroads. The laws governing yours and this other public utility are the same. You should stand for telephone bills that will compel a physical connection in the states; and then you should fight the law suit until you have brought those that dare oppose it to their knees. If additional service is required of you by making a connection with the Bell lines, you should have pay for it. We now have physical connection at La Crosse, have had it for four or five months under the order of the commission. The order is appealed from, but they cannot get rid of it without subjecting themselves to heavy fines. It is a convenience even under the arduous burdens we have today of five, ten and fifteen cents differential, a differential that I shall ask to be done away with as soon as the case is decided. Gentlemen, look this thing squarely in the face and look at it as public servants. Remember that the supreme court (and it is the everlasting reason of the thing) has said that your duty is first of all to the public, not to your stockholders. Insist on your rights.

I had a talk with my partner, who is in the United States congress, the senior member of the National Interstate Commerce Committee, Mr. Esch. He is the real author of the present Hepburn Bill, the author of the Hours of Labor Bill, the author of the Phosphorus Match Bill, and the author of the Standardization of Freight Equipment Bill. He said to me, "I believe that if congress has not given the Interstate Commerce Commission the power to authorize and order a physical connection of telephone lines doing business in more than one state, it should and will do it." Now you appeal for physical connection to the national congress, if you cannot get it under the present laws. And you should all pass appeals compelling a physical connection with the A. T. & T. lines just exactly on the same standard and same price that physical connection is given between the A. T. & T. and the Bell line. It is the duty of men and the right of men that stand as I do, members of the public, to insist that you do that thing. You have no more right to barter away the rights of the public by your contracts than did the Bell company and the Western Union in the contract which the supreme court declared contrary to public policy, and by which the Western Union disabled itself from serving any other telephone company on equal rates.

Syracuse May Get Minimum Rates

There will be no obstruction to telephone rate bills in the New York Legislature, according to the program of leading members. A hearing was to be given soon on several of these measures, including the Walters-Buecheler bill, establishing minimum rates for telephone service in Syracuse.

"I shall not take away any responsibility for the failure of the Legislature to act on rate bills," declared Senator George F. Thompson when questioned. He is chairman of the Senate Committee on Pacific Service, and also of the joint committee investigating the two public service commissions.

"With the New York Telephone Company admitting it is charging too much for service in New York city and the Public Service Commission apparently doing nothing, I can see no reason," he added, "why the Legislature should not act.

"If the company is willing at once to do what is right it would be a little different, but I shall not permit myself to be placed in a position where it would appear that I was responsible for failure to secure relief. Suppose nothing is done by the companies or the commission and the Legislature adjourns, where could relief be obtained?"

Rate bills relating to telephone service are before the Legislature. The principle generally followed heretofore has been to throw the responsibility to the public service commissions, and the Legislature has never done much for local relief.

The Walters-Buecheler bill, it is pointed out, differs from most of the bills which have come from New York and other cities. It seeks to fix by statute the rates claimed to have been provided for in the Mack amendment to the franchise owned by the company, but which the company disputes as perpetually binding. It would have the effect of putting into the law of the state the findings in the decision already made by the courts, but which are being disputed on appeal.

Michigan Third in Telephone Messages

People of Michigan are among the most inveterate users of the telephone in the world, according to a report of the bureau of census on telephones and telegraphs. A total of 240 messages for every man, woman and child in the state were sent during the year 1912. Only two states in the union, California and Ohio, have the telephone habit to a greater degree than Michigan. The number of messages per capita for the whole country, exclusive of companies having incomes of less than $5,000, increased from 65 in 1902 to 144 in 1912.

Telephone messages numbered more than 100,000,000 in 1912, an increase of 5 per cent in five years. Wireless telegraphy has become a profitable business within the last few years. A net deficit of $53,000 in 1907 was changed to a net income of about $5,000 in 1912. The number of commercial wireless companies in the country decreased from five to four, and the number of tower stations from 117 to 74. A total of 958 persons are employed by these concerns, paying salaries amounting to $394,000. The government now operates 73 wireless stations, capable of receiving messages without relay at 3,000 miles, and sending at a radius varying from 400 miles in the day time to 1,000 miles at night.

Ohio State Shows Six Per Cent Surplus

The Ohio State Telephone Company, which last July took over the Ohio telephone properties which had been controlled by J. P. Morgan & Co., reports as follows for the first six months of its organization, ended January 31, 1915: Operating revenue, $1,653,312; operating expenses, including insurance and taxes, $994,227; gross income, $569,085; bond interest, $257,103; net income, $311,981; preferred dividends, $160,967; surplus, $151,013. The surplus for the six months was at the annual rate of about 6 per cent on the common stock. The company at the time of organization provided $2,500,000 for improvements and betterments to the properties, and these are now under way. Increased earnings as a result of these expenditures were not expected to be reflected in the statements until after March, 1915.

Power Circuit Interference with Telephone Lines

Read Before the Institution of Electrical Engineers, England

BY S. C. BARTHOLOMEW

IN dealing with the subject I purpose considering separately the three different types of commercial power circuits, viz.: Electric light and power systems, electric tramways and electric railways.

The matter can be further divided into (*a*) the "lay out" of the power system as affecting interference, with telegraphs and telephone, and (*b*) the steps which may be taken to minimize those effects by alterations to the telegraph and telephone circuits. (*a*) The proper "lay out" and method of working the power system is more important than (*b*), and it differs with each type of commercial circuit. On the other hand, (*b*) the special treatment of telegraph and telephone circuits may be effective whatever type of commercial circuit is the source of the disturbance. Interference with telegraph and telephone circuits may be caused either by leakage, induction or a combination of both. Inductive effects are usually felt on telephone circuits and not on telegraphs in this country, the important exception being the single-phase railway where induction is the chief cause of interference with telegraphs. It should be remembered that transpositions and revolving as applied to telephone circuits to prevent inductive interference cannot be employed with telegraph circuits.

For the sake of brevity, telegraph and telephone circuits will be referred to generally as communication circuits, and where telephone circuits are mentioned as such, it will imply revolved lines, except where single-wire telephones are dealt with.

ELECTRIC LIGHT AND POWER SYSTEMS.

Electric light and power systems in this country are classified, according to voltage employed, under four headings: Low pressure, up to 250 volts; medium pressure, 250 volts to 650 volts; high pressure, 650 volts to 3,000 volts; and extra high pressure, above 3,000 volts. The distribution in the great majority of cases is underground, but there has been an increase in the number of overhead lines during the last few years.

Electric light and power systems are not allowed to have more than one ground connection on any distinct circuit, and this embargo has an important bearing on the matter under discussion, as the use of the earth as a return path for the currents employed is thus debarred. There is an exception to the rule, however, in the case of the Thury (England) system, and here an earth return is permissible in case of the failure of a main. However, as the current is limited to the fixed amount of 100 amperes trouble is not anticipated from this cause. It can be taken that owing to the general restriction of one earth connection for each complete circuit leakage interference is very rare from electric light and power systems.

Post office circuits usually follow road routes, whilst the high or extra-high pressure power circuits (650, say, to 20,000) volts are not allowed along roads, although they may cross roads. It is only in case where a power route runs parallel to a road, or where both routes are on private property that exposure is experienced. It is from this type of circuit that trouble has been experienced. All these circuits have practically the same system—three-phase three-wire. When the step-up transformer is star connected on the secondary side with the neutral point earthed it has an important bearing on the question of interference. The currents and voltages in the three-line wires should tend to cancel so far as producing an external field—that is, assuming, as is usually the case, that the load on the lines is balanced—and any neighboring communication circuit should be subjected only to the resultant field due to unequal exposure to each of the three lines. The effect of this can be reduced, however, by revolving or transposing the power wires in the same manner that telephone wires are revolved. It should be remarked in passing that the transposition of power wires is of great importance where the voltages are very high. A case is on record in America where a 140,000-volt line induced potentials of 2,300 volts in a neighboring telegraph line. By transposing the power wires the induced potential was reduced to between 20 and 30 volts. In addition to the resultant field due to what has been called the "balanced voltage and currents" in the power circuits there are other fields summed up as "residual voltages and currents," which

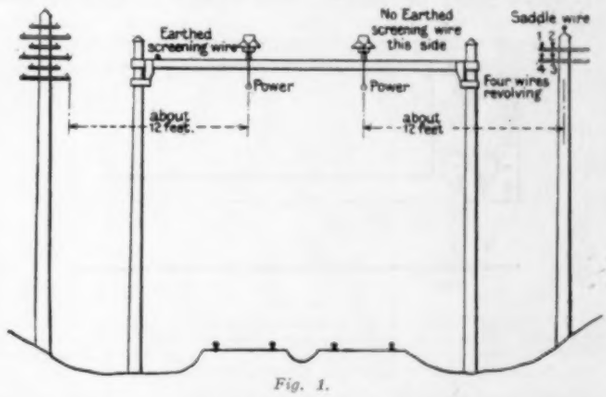


Fig. 1.

are much more serious in their effects and difficult to get rid of.

Although we have no such system in England, the highest voltage employed on an overhead line here being 20,000, we have been troubled by inductive interference in a few cases. It has been possible to remove the trouble in some instances by removing the ground connection from the neutral point of the star winding, while in other cases no improvement has been effected by such a course. The removal of the ground connection cannot be lightly undertaken on some systems, however, as when the plant has been designed to stand a certain maximum voltage engineers do not like to take the risk of subjecting it to the much higher voltage which may occur with the ground connection removed. In some such cases a resistance in the ground connection has reduced the interference to a minimum. Inductive resistance is likely to be more effective than non-inductive resistance, but there is more likelihood of dangerous surges being set up if that kind is used. It should be explained here that a resistance in the ground connection is the normal arrangement on some systems, as it limits the current in the event of earth faults, and this is no doubt a good arrangement

from the post office point of view. In the cases where the trouble cannot be removed by the insertion of resistance or removal of the ground connection the inductive effect is probably due to the resultant effect of the balanced voltages and current in the power line, and improvement is to be looked for in such a case by transposing or revolving the power lines. Such a course is of no use where the effect is due to the third harmonic. The author refers to the recommendations on this question of the Joint Committee on Inductive Interference to the Railroad Commission of California, whose report was published in Telephone Engineer.

The presence of power circuits in the vicinity of telephones always requires a high standard of maintenance for the latter. Small faults that would cause little trouble were the power circuit non-existent, now prove annoyances of considerable magnitude. Apparatus that was thought to be accurately balanced is found to be wanting when exposed to the searching effects of the strong fields. This is specially noticeable if the apparatus is earth connected, as the capacity discharge through the apparatus will effectively show up any want of balance in the impedances. It may be possible that the section of line is in perfect balance as regards insulation capacity and conductor resistance, and taken alone no trouble is experienced. The circuit is, however, liable to be placed in connection with any number of other circuits, some of which must be faulty. The faulty circuits at once

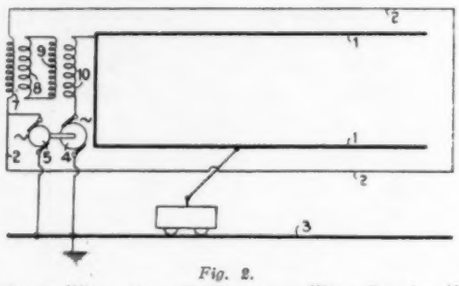


Fig. 2.

1 = Power Wire. 2 = Supplementary Wires Running Near Communication Circuits. 3 = Rails. 4 = Main Generator. 5 = Supplementary Dynamo on Same Shaft as (4). 7, 8, 9, 10 = Double Transformer.

bring on the trouble in a violent form. This latter trouble can be avoided by making all connections between the affected circuit and others through transformers or repeating coils. By this means the connection of a faulty circuit does not upset the balance on the lines subject to the interfering field. Such a procedure necessitates in certain cases alterations in the calling arrangements, and it also involves a loss in speech efficiency. There has been, however, considerable improvement in repeating coils during the last few years, and the loss should not exceed two miles.

Before leaving this portion of the paper, I should refer to two cases in which overhead wires were interfered with by underground power mains. In one instance, a single-phase system was the culprit, the main being concentric. The outer conductor was earthed at the power station, but tests showed no leakage currents. The mains being underground static effects were ruled out. The electro-magnetic effects from both conductors should have neutralized, as the mains being concentric and the current in both conductors the same, the interference was considerable, and the only conclusion that could be come to was that the conductors in the concentric main were not co-axil, and hence an external electro-magnetic field was set up.

In another case the system was three-phase three-wire with underground mains. Here the trouble was cured by inserting an inductive resistance in the ground connection to the neutral point on the starwinding on the transformer. The amount of the charging current can be gauged in this case by the fact that 10 amperes only was the normal working current on the extra-high-tension mains, and yet a current of 2 amperes was shown as passing through the ground connection, although the mains were in good order, so far as leakage was concerned. The disturbance to the overhead telephone circuits in this instance was probably due to the fact that common battery system was used, and grounded wires on the disengaged circuits carried the alternating current up into the line and so affected working circuits.

In both the above cases the mains causing the trouble could be easily traced by means of a search coil. A search coil is simply a coil of wire with a telephone receiver in circuit. A very convenient form is made by taking a piece of simplex or other tubing about three feet long, and threading through it flameproof wire 1/12½ to between 30 and 40 turns. When completed the coil should be in the form of a rectangle with sides of three feet and one foot. This can be arranged by lacing the other three sides.

ELECTRIC TRAMWAYS.

Leakage currents from tramway systems have caused trouble on telegraph circuits, even though the Board of Trade regulations have been observed, but the cases have usually been met by the addition of resistance to the circuits with corresponding increase in battery power. In certain cases where railway block signaling circuits were concerned, the provision of a metallic return had to be resorted to. It will be noted that direct current is used on these systems, and no inductive troubles might be anticipated. This is not the case, however, and although it cannot be said that there is widespread disturbance, considering the magnitude of the tramway systems of the kingdom, yet there are a number of systems giving trouble, and it is possible that some systems not causing disturbance at present may do so in the future. This last point has reference particularly to changes that may be made in the working of local exchanges—*i. e.*, the conversions of magneto changes to common battery working. The introduction of the cord circuit with grounded battery and repeating of retardation coils brings into operation conditions which are much more sensitive to inductive effects than those obtaining with the magneto systems.

It should be made clear that the disturbances produced in telephone circuits by tramways are not due to the variations in load but to high frequency pulsations. These pulsations may be divided into two, (*a*) a fluctuating note produced by the motor on the car, and (*b*) a constant note produced by the machine supplying the current. Of these (*a*) is the most common. It would appear that (*b*) was mostly associated with a particular type of machine supplying the direct current, viz., the rotary converter. As regards (*a*) this disturbance which is clearly associated with the speeding up of the cars is probably due to coils being short-circuited by the brushes, by vibration of the brushes, and by sparking. The intensity of the disturbance would appear to have some connection with the lay-out of the tramway system. In the case where an underground cable carries the main current, the trolleys being cut up into half-mile section, each of which is joined to the feeder, the static effect is confined to an exposure of half a mile, as the feeder being

underground does not come into play. In the case where the current is fed directly into the trolley wires it will be seen that an exposure of many miles to the static effect is experienced. Whatever the cause, however, on a system laid out with a continuous trolley wire known to the author, the noise from the cars far exceeds the disturbance experienced on other systems.

With regard to the pulsating current (*b*) this has not been noticed generally—it came into prominence recently. In the cases in question fairly high-pitched constant notes have been produced in telephone circuits running near the tracks, and from the constancy of the notes it was assumed that alternating current mains were to blame. The first case of this kind that I investigated appeared mysterious, as no disturbance could be picked up with a search coil at the point where the telephone and power lines were in close proximity, and trouble might be expected, the lines being widely divergent at all other points. The reason for this was seen subsequently when it was ascertained that this particular section of the route was fed by a separate direct-current machine with its own prime mover. In this case it was possible to detect the presence of the pulsating current produced by the rotary converters at a distance of 50 yards from the track by the aid of a search coil, and the power engineer was quite astonished at the behavior of his direct-current mains. The note could also be picked up from iron railings and neighboring pipes, and it was the easiest thing possible to trace the course of the underground power mains all over the system. Since this case came under notice others have developed, and there is little doubt that to a telephone engineer there is something sinister about a rotary converter. There are three likely steps that may be taken to reduce or remove the pulsating current. If the tramway system has stand-by batteries those kept floating in circuit should absorb all the pulsations. A choking coil would also no doubt flatten out the ripples, but there might be difficulty in designing a proper coil so as to effect the purpose and yet keep the losses within reasonable limits. A third method which I have tried with some success is to short circuit the machine with condensers. The tests I have made have been only trial and error, as in the case in question the frequency and voltage of the ripple were unknown, but all observers agreed as to the reduction in the noise.

A very great improvement was effected in the case referred to by a different arrangement. The trolleys are fed from sub-stations several miles apart, and it was ascertained that the greatest disturbance occurred when both stations were in operation feeding the line in parallel. By the simple expedient of disconnecting the trolleys at a point halfway between the stations the pulsating current was reduced considerably. The rearrangement simply means that each sub-station will supply one portion of the system only. There may be times of very heavy traffic when the stations will be required to assist each other, but these will be rare.

As regards steps to be taken with telephone circuits, the first case to be considered is the single wire telephone circuit of which there are still a number in existence. The usual method is to double the circuit for the section parallel to the disturbing route, transformers being used at the junction of the single and double wire section. There is also another method, which depends upon choking out the alternating current from the receiver portion of the circuit by means of the impedance coils. The coils, of course, also reduce the speech currents, and to make up for this as much as possible the battery power and induction coil ratios are increased. There is bound to be some reduction in speech volume, and it is essential that good transmitters be employed. Another simple remedy which is sometimes effective is to bridge the telephone receiver by a small condenser. Here again good transmitters are required.

As regards double wire telephone circuits perfectly balanced circuits are essential, and if the exchange system is common battery some alteration may be necessary to dissociate the exposed line circuit from direct connection with the earthed battery and repeaters or coils by means of transformers. This, of course, means a certain loss in speech and a departure from standard practice.

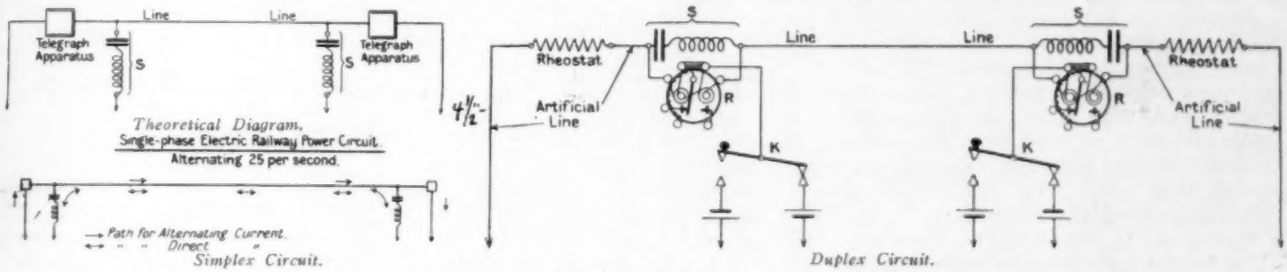


Fig. 3. K = Key Signaling. R = Relay. S = Resonant Shunt.

ELECTRIC RAILWAYS.

There are two systems of electric traction employed on railways in England—continuous current and single-phase alternating current. The former system is that commonly used, but it is the latter with which this paper is most concerned, as it has apparently proved a bugbear to telegraphs and telephones in whichever country it has been introduced.

There have been a number of cases of leakage from continuous-current railways which have been overcome by one means or another. The first electric railway in London—the South London—caused interference in its early days, but this disappeared when a different method of feeding was introduced. The Central London Railway also gave rise to considerable trouble on the telegraph circuits with offices near the route. Improvements made on the railway system brought about some relief, but resistance coils had to be inserted permanently in certain circuits. The multiplication of the electrical railways and tubes in London has not, however, brought about much trouble with the actual working of the circuits, but this is not due to any special virtues of the railway systems, but to the fact that high resistance polarized sounders are now in general use in London. Induction has not been much in evidence from these railways, although it was found necessary some years ago to double a telegraph circuit working with an undulator where it ran parallel

to the electrified section of the North Eastern Railway at Newcastle.

SINGLE-PHASE RAILWAYS.

The most serious troubles with single-phase railways have occurred in America and Germany, and there has been a considerable amount in this country where we have two railways employing the system. Now the "lay out" of the railway is most important, as it considerably affects the question of interference, and to bring this point out I propose to put before you notes I have on the effects on each of four railways—one American, one German and two English railways. A brief description of the general system will suffice. Alternating current at extra high pressure with a periodicity of usually 15 or 25 per second is fed into an overhead contact wire through a bow collector to a transformer on the train, and from thence returns through the wheels to the source of supply via the rails and earth, and in some cases, and this is important, through subsidiary cables or wires. Such a system will produce effects on neighboring communication circuits which can be summarized as follows: (*a*) Earth currents or leakage from the track rails, (*b*) Electromagnetic induction from the contact wires, the track rails, and the conductors in the cables at the side of the track (if there are any such). (*c*) Electrostatic induction from the trolley wires.

New York, New Haven & Hartford Railway.—This American railway has at present over 50 miles of track operating single-phase. The voltage is 11,000 with a periodicity of 25 per second. The simplest possible lay out was originally provided, the current being fed into the contact wire from one generating station with the rails and earth as a return. As would be expected, this working had considerable effect on the neighboring communication lines. The principal effect was electromagnetic induction, the electrostatic effect being negligible. Three communication circuit lines were affected, and I give briefly the effects on each.

Shore Line.—Length of open line about 23 miles, at distances varying between 100 and 5,600 feet from the railway. The circuits on this route had voltages of 300 induced in them, sufficient indeed to operate the lightning protectors. In addition to the above voltages, which were induced by the fundamental current of 25 frequency, there were higher frequencies produced by the motors when the trains were running which had a serious effect on the telephone circuits.

New York, New Haven Subway Cable.—The cables in ducts in a subway are concerned in this section 25½ miles. The separating distance from the railway varied between 300 to 5,600 feet. The induced voltage on the circuits traversing the whole route with maximum load on the railway was 170 volts. Shorter circuits had under similar conditions 75 to 150 volts induced. Attention is particularly drawn to the fact that underground wires in cables are referred to here.

Midland Line.—This open line runs roughly parallel to the railway with a separating distance of from four to five miles. The length of the line is 30.4 miles. These circuits had 40 volts induced in them. Occasionally, when short-circuits occur between the railway trolley wires and the rails, the high voltage operates the protectors and rings the subscribers' bells. To overcome these large induced voltages "neutralizing transformers" have been used on the telegraph and telephone circuits with fairly satisfactory results, except so far as reducing the noise on the shore line circuits. The application of these neutralizing transformers is based on C. F. Scott's patent specifications Nos. 14,752-3, 1907.

The transformers contain either 18 secondary pairs and eight primary pairs or 22 secondary pairs and eight primary pairs. The wires joined to the primary coils are earthed at each end of the route or section exposed to the influence of the electric railway, and it is arranged so that the induced effects in the primary wires tend to neutralize through the transformer the induced effect of the power circuit on the secondary circuits—*i. e.*, the circuits to be protected. At first sight it would appear that the primary wires would be lost for commercial use, but by a method of superimposing on pairs it has been found possible to utilize them for telephone circuits. The transformers are so designed that with a periodicity of 25 cycles per second, and with the normal e.m.f. induced by the railway power circuit, an induced potential of 75 volts is produced on the secondary circuits opposing that due to the railway circuit. It is, therefore, possible by arranging for a sufficient number of these transformers in series to nullify any induced potentials, each transformer disposing of 75 volts. The transformers cause a transmission loss on all telephone circuits to which they are connected. This amounts with three transformers in circuit to 0.6 mile of standard cable in a secondary circuit, and 0.7 mile in a primary circuit. It is stated that there is no appreciable "cross fire" between the telegraph circuits working on the transformers. This may be so with circuits working at hand speed, but it is doubtful whether interference would not take place with high-speed working.

It should be noted that the transformers are effective only in reducing voltage effects, and have yielded no improvement in respect of the high-frequency noise on the circuits.

In the early part of this year a modification was made in the layout of the railway, which, it is claimed, has effected a cure for this inductive trouble. The new lay out was designed partly to meet the growing demands on the power supply of the system, and incidentally to improve the conditions so far as interference is concerned. The new lay-out involved the introduction of auto-transformers.

Dessau-Bitterfeld Line.—This single-phase line, installed by the Prussian Railway Administration, is some 15 miles long. The simple lay-out adopted on the New York, New Haven, in the first instance, is employed—that is, overhead feeding with a bonded rail and earth return. The system works with 10,000 volts at a periodicity of 15 per second. The Imperial telegraph line with important foreign circuits ran close to the track at an average separating distance of about 25 feet. These circuits were so disturbed that other routes removed from the railway had to be taken. Very elaborate investigations were made into the effects on the abandoned wires by O. Brauns. The induced electromagnetic voltage found to exist was quite startling. Calculating from the observed tests it was shown that with a 25 miles' exposure and with full-load on the power lines, a voltage of 800 would be induced in neighboring telegraph circuits 250 volts was actually measured with a moderate load, and to quote from a translation of an article on the subject: "It is consequently no longer remarkable that arc lamps which were connected to the wires at the Dessau Telegraph Office burned well." The induced current taken from the parallel connected telegraph wires was 20 amperes, which with this voltage amounts to 5 kw.

Similarly strong currents were induced in single

wires in underground cables, and the conclusion is drawn that with both overhead and underground there is danger to life if contact is made with these telegraph circuits. It was shown by an oscillograph record that the static effect of the power circuit voltage produced a fundamental wave of 15 per second, on which were 900 harmonic oscillations. This came from the main generator, which had a speed of 900 revolutions per minute, and has 60 slots, which means that 900 slots crossed the poles per second. In addition, from oscillographs taken when a train was running, it was shown that the harmonic oscillations shown thereon could only have been produced by the reaction of the motor slots on the main power current, the number of oscillations agreeing with the speed at which the train was moving.

Midland Railway.—The system between Lancaster-Morecambe-Heysham is also laid out on the same simple plan, the current with voltage 6,000-7,000 at 25 per second being fed into the lines at Heysham, and returns via the rails and earth. The return path of the current was originally reported to be somewhat obscure. The rails are connected to ground plates in the River Lune at Lancaster, and in the sea at Morecambe and Heysham. It was stated that recording instruments in these earth connections have not indicated any current passing to earth. Tests made to ascertain the currents flowing in the rails also drew blank except at a point quite near the generating station. On this matter it is well to remember that steel rails offer a considerable reactance to alternating current, and no doubt in suitable soil the return current is more likely to take a path through the earth. The department has only a few wires on the Midland Railway at this point, the greatest exposure being four wires between Lancaster and Morecambe, distance about four miles.

One of these was a single wire telephone circuit which was, of course, rendered quite useless when the electric working was introduced. A quad circuit with *A* side relayed is subject to interference at times, but normally the disturbance can be biassed out. With an extension of the railway system this would probably be impossible, as interfering electromagnetic voltage increases with the length of exposure, and would soon reach a point at which the circuit voltage would be interfered with. About 16 volts (virtual) has been observed in neighboring telegraph circuits as the combined effect of electromagnetic induction and leakage, but the loads were not heavy at the time, and would be considerably greater in the holiday season.

Some interesting experiments were carried out in co-operation with the Midland Railway Company's officials. In the first case it was desired to ascertain what actual loss of speech was occasioned by the noise introduced into a telephone circuit by the railway. It was found that a telephone circuit running for a portion of its route on the railway had a speech value of 7 miles of standard cable with the railway not working. This was increased to 18 miles of standard cable with the railway in operation—that is, there was a loss of 11 miles owing to the inductive effects of the railway. The portion of the circuit on the railway was not revolved, however, and Mr. Sayers of the Midland Company agreed to erect a properly transposed loop, to ascertain whether the trouble could be overcome by that means.

An endeavor was made at the same time to reduce the interference, but the arrangement tried was only partially successful. Another point was also investigated at the same time by the aid of this specially erected line. It has been the experience with railways erected on the Continent that dangerous electrostatic charges were induced on insulated communication circuits adjacent to the tracks, and to reduce this if possible the Midland company had erected a grounded wire between the power circuit and the telegraph line running parallel to the track. The position of the wire is shown in Fig. 1. The effect of this wire combined with the grounded telegraphs on the same line resulted in a considerable reduction of the electrostatic potential. By comparison, it was proved that the wire shown in the saddle position on the right-hand side of the figure—that is, on the side not provided with a grounded screening wire—was 320 volts (virtual), while a wire on the route on the screened side, and of the same length as the other wire, was charged to 48 volts only, a reduction of about one-seventh. At the time this test was taken the saddle wire was the only one in position on the unscreened side. The tests were taken with a multicellular voltmeter, and roughly checked with a current measurement of the charge by earthing at one point through a high resistance, a Duddell thermo-milliamperemeter being used for the current measurement. These tests were taken with no trains running, as it was found that the electrostatic effect on an insulated wire was reduced immediately current was being taken by a train. The reverse is, of course, the case as regards electromagnetic induction, as it depends upon the load.

To ascertain more definitely the screening action of one or more wires on the same poles, No. 1 wire, shown in Fig. 1, was earthed at one point through a thermo-milliamperemeter, and the other wires were systematically grounded or disconnected, as shown in the following table, in which is also shown the current readings with the varying conditions:

Milliamperes Observed	Condition of Other Wires			
in No. 1.	Saddle Wire.	No. 2.	No. 3.	No. 4.
26.1	Dis.	Dis.	Dis.	Dis.
21.9	Earthed.	Dis.	Dis.	Dis.
18.6	Dis.	Earthed.	Dis.	Dis.
18.9	Dis.	Dis.	Earthed.	Dis.
18.6	Dis.	Dis.	Dis.	Earthed.
15.3	Earthed.	Earthed.	Dis.	Dis.
12.3	Earthed.	Earthed.	Earthed.	Dis.
9.9	Earthed.	Earthed.	Earthed.	Earthed.

It should be noted that these reductions are due to grounded wires on the same pole line and that the wire erected by the railway company, which is grounded at frequent intervals and is in close proximity to the power wires, has probably a relatively greater effect.

The railway company in the early days of the system grounded through resistances all insulated wires at intervals to drain off the induced charges so as to render them safe for handling.

Mr. Sayers of the Midland Railway Company patented a method for eliminating or reducing electrostatic and electromagnetic induction between contact wires of electric traction systems and adjacent communication circuits, and I reproduce the drawing in the specification, Fig. 2.

The method is briefly as follows: Two special wires are run in proximity to the wires interfered with where they are parallel to the railway. These special wires are charged from a dynamo which is run off the same shaft as the generator supplying the contact wires. The effect produced by this dynamo in the special wires counteracts the electrostatic disturbance produced by the trolley wires on the neighboring circuits, as the two effects are 180 degrees out of phase. In addition, the trolley wire is taken through a double transformer, of which the two special wires form one of the windings. This arrangement is for counteracting the electromagnetic effect pro-

duced by the contact wires, as the currents in the contact and special wires will be 180 degrees out of phase with each other.

Mr. Sayers subsequently simplified the method by an arrangement in which special wires and dynamo are dispensed with, the telephone wires being electrically connected through condensers to the secondary of a transformer, the primary of which carries power circuit current. It will be observed that one of the condensers is variable. Mr. Sayers has been able on experimental lines to produce a silent circuit with this arrangement. It is feared, however, that there are dangers and difficulties in its application, which would prevent it being a satisfactory arrangement for use under working conditions.

London, Brighton & South Coast Railway.—This railway is of great interest, in that a serious attempt has been made in the lay-out to prevent leakage and electromagnetic induction, and although the result has not been successful, the steps taken have undoubtedly minimized enormously the injurious effects arising from those causes. The contact wires are sectionalized, and are fed from feeder or distribution cables laid alongside the track. This reduces the electromagnetic disturbance to some extent. The principal steps have been taken, however, with the return of the current, two conductors being employed to assist the return of the current apart from the rails and earth. One of the return conductors, the "distributor outer," is connected to the rails by a copper bond. With the original installation between London Bridge and Victoria each rail was connected to this distributor outer, but on the extension this has been modified, the rails being bonded together, and a connection made to the distributor outer at intervals only. The other return conductor, called a "booster" cable, is connected to the distributor outer, and so to the rails at a few points only. Both these cables run beside the track, and if the whole of the current returned in them it would have a considerable neutralizing effect in counteracting the electromagnetic induction from the trolley wires and the distributors.

In spite of these arrangements, however, interference with telegraphs and telephones has not been eliminated, and a number of circuits had to be diverted from the railway owing to interference with the working. Numerous tests have been made of the effects produced by the working of the railway, and although a full account cannot be given here, some indication may be given of the investigations. In the first case no dangerous electrostatic effects were observed, even when there were no trains running. This is probably due to the grounded structures carrying the contact wires, and to the numerous grounded telegraph wires on the route.

The combined electromagnetic and leakage effect on a certain line reached 30 volts (virtual) at times. This line runs for nearly six miles parallel to the railway. The interfering voltage required to disturb telegraph signals varies with the type of apparatus employed, the voltage on the telegraph circuit and the speed of working. It may be interesting to describe a method of reducing the effect on telegraphs by employing what is described as a resonant shunt (see Fig. 3). The shunt consists of a capacity and inductance of amounts such as to be resonant to currents of the frequency induced by the railway power circuit. The theory is that the shunt provides a path of low resistance for alternating currents of the frequency it is designed to take, while affording no path for the direct current operating the circuit. It will not take away all the alternating current. the amount depending upon the respective resistances to the alternating current of the paths through the apparatus and the shunt. It should have a low resistance, therefore. Fig. 3 shows how the shunt is applied to simplex and duplex circuits. In the case of duplex the effectiveness of the shunt is reduced by the fact that the resistance in the rheostat forms a part of the path to earth, but an advantage is obtained in the application by the fact that there is an alternative path through one coil of the relay for the shunt current which tends to neutralize the effect of the induced current taking the relay route. The formula used for arriving at the correct makeup of the shunt is

$$n = \frac{1}{2\pi\sqrt{KL}}$$

where K is the capacity in farads, L the inductance in henries, and n the frequency of the power circuit. n in this case is 25, and by allowing for microfarads instead of farads the product of KL should amount to 34.27. Now, it is obvious that 34.27 can be made up in numerous combinations of capacity and inductance. There are disadvantages with high capacity or high inductance. If a high capacity is employed it will seriously reduce the signals on certain types of circuit, while a high inductance involves a high resistance to produce the inductance unless considerable iron is used for a coil, and high resistance will defeat the object of the shunt. Again, if iron is used, then the inductance will vary with the current passing, and the shunt will cease to be resonant at all values of current. An air coil inductance is to be preferred on this account, but the resistance would have to be high to produce a reasonable inductance figure. It can be said, however, that it is possible by means of these shunts to make certain circuits workable which would otherwise be unfit for use. Its use is limited, however, to circuits worked at hand speed, as with automatic working at certain speeds the signals are distorted, owing to the shunt coming into action, and providing a path for the working current.

The induced voltage which can be impressed on a telegraph circuit without interfering with the working will vary with the type of apparatus employed, and with the same apparatus even mechanical deviations will make differences in this respect. American and German figures are perhaps not much good for comparison here, as the apparatus has different resistances and figures of merit from our own. The German telegraph officials state that the service was rendered unreliable or interrupted by alternating currents of 14 to 17 periods when the alternating-current strength-using sounder was 20 per cent. Morse recorder 15 per cent, and Hughes apparatus 10 per cent of the continuous-current strength necessary for working the system.

There are several variations in applying the resonant shunt and other methods which will reduce the actual effect on the telegraph apparatus. A copper tube between the electromagnet and the windings will damp out the effect of the alternations on the relay—*i. e.*, the application of the same principle used in making relays, which will not respond to ringing current in telephone systems. On a double current simplex circuit it is possible to reduce the interference by utilizing one coil only on the relay, the other coil being short circuited by being connected through the 75ᵂ coil of a seven terminal transformer, the line wire passing through the other 75ᵂ coil. By having the coils in opposition the effect of the induced current is reduced at the relay by the secondary effect of the transformer.

Recent Telephone Patents

A Brief Digest of those Current Specifications Most Interesting to Telephone Men

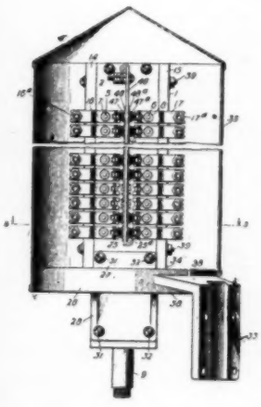
BY DAVID S. HULFISH

PATENT No. 1,126,701. Semi-Automatic Telephone System. Issued to A. M. Bullard, New York, N. Y., assignor to Western Electric Company, New York, N. Y. (Application filed April 3, 1907.) In a semi-automatic system having central offices in the same exchange area, several automatic selective operations may be necessary to select a desired distant office. This is arranged so that the depression of a single key will cause all necessary operations for the selection.

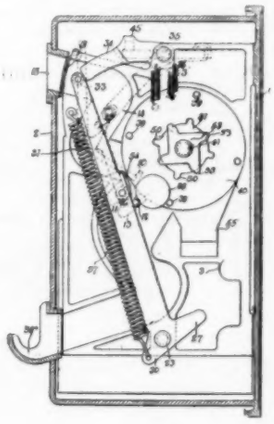
1,126,727. Selector Switch. Issued to H. G. Dietl, Vienna, Austria-Hungary, assignor to Western Electric Company, New York, N. Y. In a selector switch, current is conducted to a movable brush by collector segments, two segments being shown, with a multiple brush, one brush of the multiple always engaging a collector segment.

1,126,733. Cable Terminal. Issued to H. W. Dunbar, Newark, N. J., assignor to Western Electric Company, New York, N. Y. The protective devices use three sides of a square box cable head, the tubular fuses along two sides, and the carbon arresters on front, the fuses projecting past the corners of the box to engage the arrester parts.

1,126,751. Counter for Telephone Stations. Issued to M. M. Goldberg, Dayton, Ohio, assignor of part to V. F. King, Dayton, Ohio. In a telephone coin box device, a



1,126,733.



1,126,751.

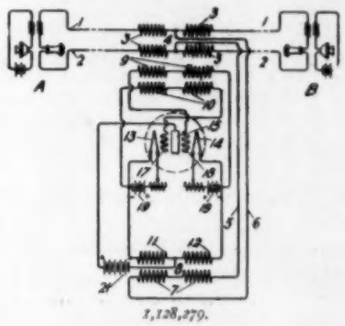
counter and a spring to actuate the counter when released from the central office, and a manual calling arrangement which at the same time calls the central office and sets the spring under tension preparatory to operation of the counter.

1,126,803. Automatic System. Issued to F. R. McBerty, New Rochelle, N. Y., assignor to Western Electric Company, New York, N. Y. (Application filed Oct. 8, 1908.) A call sending apparatus for central office has a series of contacts and a finder brush for traversing them, and mechanism whereby a selecting switch and the finder brush move in unison until the finder brush reaches a predetermined point, the finder brush thus determining the extent of the selective movement of the selecting switch.

1,126,804. Power System for Automatic Exchange. Issued to F. R. McBerty, Antwerp, Belgium, assignor to Western Electric Company, New York, N. Y. In a switchboard having switches driven by power shafting, two systems of shafting are provided, and alternate switches are coupled to the first and second shaft systems, as an insurance for operation of some switches should one source of power fail.

1,126,952. Semi-Automatic Telephone System. Issued to A. M. Bullard, New York, N. Y., assignor to Western Electric Company, New York, N. Y. (Application filed April 3, 1907.) Where two switches are needed for connecting two lines automatically, the first is arranged to give a busy tone if the desired line is busy, and the second switch is released.

1,126,956. Equalizing Potentials of Grounding Points. Issued to A. B. Clark, assignor to American Telephone & Telegraph Company, New York, N. Y. A method of killing



1,128,279.

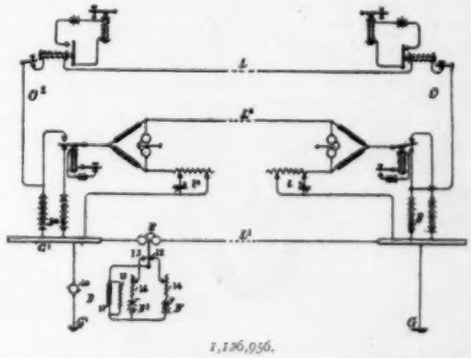
earth potentials between the ends of telegraph lines; a counter electromotive force is introduced in one of the earth wires.

1,126,963. Semi-Automatic Telephone System. Issued to A. H. Dyson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. A calling line must select a connecting switch and also an operator's call sender. The system is arranged that both of these selective actions are started at the same time.

1,127,050. Call Sender for Automatic Telephone. Issued to F. R. McBerty and A. H. Adams, Antwerp and Brussels, Belgium, assignors to Western Electric Company, New York, N. Y. A call sender in which a series of impulses are sent, the impulses being all of the same duration except the last, which is longer than the remainder.

1,127,161. Head Band. Issued to Nathaniel Baldwin, Mill Creek, Utah. Additional facility for adjustment is obtained by mounting each of two receivers upon a short rod, the rod being clamped by the ends of the head band.

1,127,405. Telephone Trunk System. Issued to E. H. Clark, Austin, Ill., assignor to Western Electric Company, New York, N. Y. In a telephone trunk line, an automatic selector is provided at each end, the two selectors moving



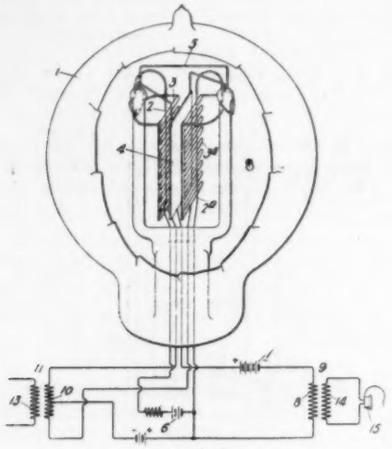
1,126,956.

in unison and being controlled over the speaking pair of the trunk.

1,127,437. Cord Circuit. Issued to J. E. Hilbish, La Grange, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. A universal cord circuit for interconnecting magneto and common battery telephone lines.

1,127,466. Selective Controlling Apparatus. Issued to F. R. McBerty, New Rochelle, N. Y., assignor to Western Electric Company, New York, N. Y. Instead of a searching brush moving over fixed points, a series of relays is used, the relays being charged successively in step-by-step order, until an indicating wire is engaged.

1,127,467. Trunk System. Issued by F. R. McBerty, New Rochelle, N. Y., assignor to Western Electric Company, New York, N. Y. Where several sets of trunks are



1,128,280.

used from different switchboard positions, or from different offices, an overflow trunk has an intermediate selector for searching out idle trunks of another set.

1,127,513. Paper Condenser. Issued to Albert Preussman, Chicago, Ill., assignor to Western Electric Company, New York, N. Y. A paper condenser roll is placed in a case and the case is poured with a compound of asphaltic cement and Montan wax.

1,127,808. Sequence-Switch. Issued to J. N. Reynolds, Greenwich, Conn., and C. F. Baldwin, Montclair, N. J., assignors to Western Electric Company, New York, N. Y. According to this patent, a "sequence switch" is a complex relay having a multipositional armature. In the device of this patent, the armature is of disks having projecting conducting teeth of irregular angular arrangement, the local circuits being made by the engagement of those teeth with fixed contacts, a sort of cylindrical sign-flasher device, which takes its name "sequence switch" from its use rather than from its nature.

1,127,876. Selective Signaling System. Issued to J. C. Field, Orange, N. J., assignor to Western Electric Company, New York, N. Y. A station selecting device for lines having several stations, the selecting mechanism being step-by-step.

1,127,889. Telephone Ringing and Signaling Circuits. Issued to E. E. Hinrichsen, Alexander, Ill., assignor to Western Electric Company, New York, N. Y. While ringing with alternating currents upon a telephone line, the closing of the telephone bridge for direct currents operates two relays at the central office, a fast and a slow relay, the successive operation of the relays effecting the proper operation of central office signal circuits.

1.128,019. Call Timing Device. Issued to D. J. McGauran, Geraldton, Western Australia. When a telephone sta-

1,128,562.

tion is rung, a timing device is set in operation and is stopped if the ring is answered within a time limit.

1,128,262. Telephone system. Issued to H. S. Turner, SanDiego, Calif. When the subscriber lifts the telephone receiver, he hears a tone upon the line, indicating that his central office apparatus is in working order, and when the operator answers the tone is discontinued. A tone is given to the operator also whenever a line upon her position is calling.

1,128,279 and 1,128,280. Speech Relay. Issued to H. D. F. Arnold, East Orange, N. J., assignor to Western Electric Company, New York, N. Y. The structure used is a thermionic detector, comprising audion elements in a sealed glass container, associated with suitable circuits for connecting with telephone wires.

1,128,292. Speech Relay. Issued to E. H. Colpitts, East Orange, N. J., assignor to Western Electric Company, New York, N. Y. This patent also uses the ion detector of the pair of patents above, using a detector of two ionized paths used differentially against each other.

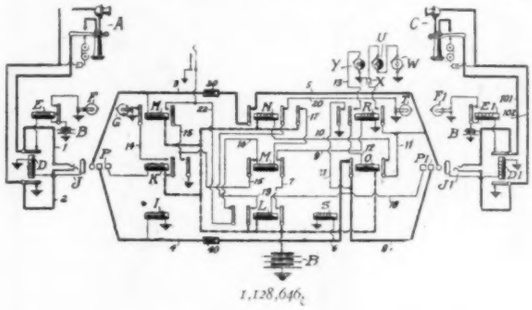
1,128,469. Automatic Telephone Exchange. Issued to G. W. Lorimer, Piqua, Ohio, assignor to Western Electric Company, New York, N. Y. (Application filed May 31, 1906.) A main starting switch is adapted to search over a number of line finders and start one of them when a call is received. In case a call is received and no linefinder is idle for service, the starting switch is unable to search.

1,128,562. Relay. Issued to H. G. Webster, assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. (Application filed Sept. 28, 1907.) The relay has one core and two armatures, both arranged over the free end of the core, and designed that a smaller current will attract one armature and a larger current will attract both of them.

1,128,646. Ringing System. Issued to J. L. Wright, Washington, D. C., assignor to F. C. Stevens, Attica, N. Y. A specific arrangement of relays for "machine ringing," and for enabling the called subscriber to stop the automatic repeating ringing.

1,128,660. Meter for Call Distributor. Issued to H. P. Clausen, Rochester, N. Y., assignor to Western Electric Company, New York, N. Y. Call-distributing trunks are equipped with linefinders, each such trunk having a counter, with circuits for controlling the operation of the counters.

1,128,701. Test System for Automatic System. Issued to F. A. Lundquist and J. J. Brownrigg, Chicago, Ill., assignors to Western Electric Company, New York, N. Y. (Applica-



1,128,646.

tion filed May 19, 1903.) The test circuit has a resistance coil in series with the test relay. The first switch to test the line has but one such resistance and the test relay has insufficient current for operation, hence the line is taken as idle; the next switch to test the line finds its resistance elements shunted by the resistance element of the switch already in possession, reducing the resistance of the test relay circuit, the relay is operated, and the line rejected as busy.

1,128,777. Telephone System. Issued to C. E. Hague, Rochester, N. Y., assignor to Western Electric Company, Chicago, Ill. In a call distributing system, two calling signals may be displayed before an operator simultaneously, but not more than that.

1,128,857. Selecting System. Issued to E. B. Craft, Hackensack, N. J., assignor to Western Electric Company, New York, N. Y. In combination with a step-by-step device for party line stations, circuit may be closed through the bell coils or through the bell coils in series with a bell armature contact, whereby the bell is rung as a vibrating bell, the selected bell alone being vibrated. If, when circuit is closed through all bell coils, a pulsating current is placed upon the line, all of the bells of the line are operated and a general call is made.

1,128,927. Telephone Repeater System. Issued to D. H. Wilson, New York, N. Y. An arrangement of speech relays and repeating coils is shown for use upon a grounded telephone line.

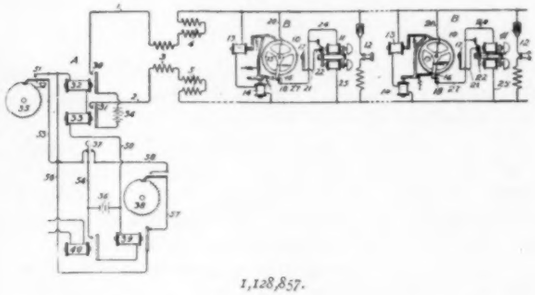
1,128,930. Telephone System. Issued to F. V. Young, Lyndhurst, N. J., assignor to Western Electric Company, New York, N. Y. An operator's set is normally connected to a telephone line, but a ringing generator may be substi-

tuted, an automatic release being made when the ring is answered to restore the line to the operator's set.

1,128,943. Speech Relay. Issued to S. G. Brown, London, England. The specific feature of interest is that the electrodes in contact are approximately one-tenth of an inch in diameter.

1,128,944. Speech Relay. Issued to S. G. Brown, London, England. In this relay, the microphonic electrodes are three-tenths of an inch in diameter, and are so arranged as to avoid initial pressure, with granular material initially uncompressed between them.

1,129,087. Receiver. Issued to E. Grissinger, Buffalo,

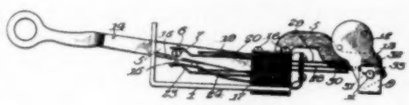


1,128,857.

N. Y. The telephone receiver diaphragm is held between wire supports which are under tension, with a connection between the central portion of the wire and the armature of the diaphragm.

1,129,357. Lightning Protector. Issued to M. G. Mitchell, South Bend, Ind., assignor to National Standard Company, Niles, Mich. A fixture for the outside of the house. The terminal blocks of the line wires are approached by an earthed block to spark gap distance for arresting lightning.

1,129,543. Automatic Telephone System. Issued to Gotthilf Angarius Betulander, Villa Castor, Sodertorns Villastad, Sweden. A number of series of selecting relays corresponding to the numbers to be selected and adapted to register the current impulses and circuits controlled by the selecting relays and controlling certain combining relays to



1,129,808.

connect certain telephone lines. This is perfectly intelligible to any one who has preliminarily a thorough knowledge of the Betulander automatic telephone system.

1,129,808. Hook Switch. Issued to Oscar M. Leich, Genoa, Ill., assignor to Cracraft-Leich Electric Company, Genoa, Ill. A hook switch having switching springs and a hook lever for operating them, and having an automatic delaying device whereby with the movement of the hook lever in either direction the operation of the springs, or some of them, will lag behind the time of movement of the hook lever. The delaying device is a weight and trigger. By this means three hook-switch conditions may be had, up, down, and an intermediate condition, and the intermediate condition may be prolonged sufficiently to send a reliable signal.

Guide for Preparing Technical Papers

There undoubtedly exists the necessity for some more or less detailed directions concerning the points to be considered in the preparation of papers for professional societies. There are in the membership of such organizations a large number of young men who, either by reason of education or of lack of practice, are not familiar with the best and easiest methods for the production of literary results and to whom such a guide would undoubtedly be of considerable assistance. That there may be many older men who are in the same position need not be discussed.

In connection with the work of one of the technical committees an effort has been made to develop such a guide, but its usefulness would not be limited to any committee or to any society.

In order to obtain the best results it has been the desire to bring together as many suggestions and to focus as much discussion on this as possible, and with this idea a tentative outline, which has already been circulated within narrow limits, is published herewith, with the request that all criticisms and suggestions upon it will be welcomed by the writer, who is desirous of having this matter in shape before the end of the administrative year.

Following are suggestions for the preparation of a professional paper and principles involved in technical writing, says the *Proceedings of the A. I. E. E.*:

Occasion for writing—Class of readers: Laymen, specialists.

Classification of engineering writing: Description, narration, exposition, directions, criticism, argument.

General principles: Accuracy, completeness, length and economy.

Preparation: Outline and synopsis, collection of data and illustrations.

Investigations regarding preceding publications on the same subject.

References and credit to previous authors.

Outline of paper: Title (Suggesting the Subject.)

Summary or Abstract. (Brief abstract of the main features of the paper.)

Introduction. (Definition of the subject to be written up so as to give the reader a clear understanding of the subject which the paper is to cover.)

Body. (Solution of the problem. Should include all parts or points which would be advantageous for the reader to consider. Description of each part and explanation of the relation of the parts to each other.)

Conclusion. (Should include a brief summary of the points which in the body of the paper were brought out in detail. Suggest some new useful property or application.)

Bibliography. (On many subjects it is advantageous to give a list of references to previous articles on the subject.)

Toll Rates to the Coast

Some of the rates established for service to the Pacific Coast follow:

To San Francisco from	Three Minutes.	Additional Minutes.
Chicago	$14.45	$4.50
Minneapolis	14.45	4.50
St. Paul	14.45	4.50
St. Louis	14.45	4.50
Milwaukee	15.45	4.85
Detroit	16.70	5.25
Cleveland	16.95	5.35
Toledo	16.45	5.15
Columbus	16.45	5.15
Cincinnati	16.45	5.15
Dayton	16.45	5.15
Indianapolis	15.95	5.00
Omaha	12.70	3.90
Des Moines	13.70	4.25
New York City	20.70	6.75

Panama Grants 25 Year Franchise

The government of Panama has just granted to Enrique Halphen & Company, of David, Panama, a concession for 25 years for the construction, maintenance, and operation of a modern telephone line in that city and suburbs. All material necessary for its construction, preservation, and operation is to be admitted free of duty. The work must begin within 10 months from the date of this contract, January 20, and the concession can not be transferred to other parties without the consent of the authorities. Five instruments must be installed and operated free of charge by the company in offices to be designated later, and the government agrees to rent 10 others at the rate of $2 a month for each.

Public Utility Commission News

Reports Concerning the Activities of State Regulating Bodies in the Telephone Field

New York

A BILL prepared by the Foley Telephone Investigating Committee transfers from the up-State Public Service Commission to the New York Commission jurisdiction over local telephone rates in New York and Long Island and puts under the supervision of the up-State Commission about 1,000 telephone lines in country districts not now subject to state regulation.

Telephone companies are classed by the bill as commercial and mutual. The Public Service Commissions are empowered to establish standards of service for both classes.

The most important amendment proposed gives the commissions the same control over issues of stocks and bonds and the transfers and sale of property by telephone companies that is now exercised over railroads. Holding companies, such as the American Telephone and Telegraph Company, are subjected to complete regulation.

The Public Service Commissions are given further power to suspend the taking effect of advanced rates pending an investigation as to whether they are fair.

Pennsylvania

Complaint made to the Pennsylvania State Commission by the Norwich Telephone Company alleged that the terms of the contract for joint exchange and toll services, rates and charges, between that company and the Bell Telephone Company of Pennsylvania, were unreasonable and discriminatory.

Held that the charges of the Bell company contained in said contract are reasonable and not discriminatory, but the Bell company is ordered to adopt certain practices set out in the report of the commission, as follows:

That in order to lessen the expense and time of the agent or representative of the complainant company in the collection of the toll charges, the respondent furnish to each subscriber of the complainant monthly statements showing the amounts due from such subscriber for toll messages, with information as to the number of toll messages from said subscriber, and from non-subscribers with their names, station called, date, etc.; and furnish to the agent or representative of the complainant a duplicate copy of each of such statements with a sheet having a detailed summary thereof.

The Central District Telephone Company (Bell) has filed a new schedule of rates for the Johnstown interurban district to be effective April 21 and the complaint of the Johnstown Telephone Company against the Central District has been withdrawn.

The new schedule makes a number of changes in toll rates. The zone to Portage and Ebensburg from Johnstown is made a 10-cent field and points at Creson and Gallitzin, from Johnstown, will be 15 cents. A part of the 5-cent field is raised to 10 cents and part of the 10-cent field to 15 cents or more.

Johnstown Telephone Company states that the withdrawal of its complaint was because of the fact that the Bell Company had filed a complete schedule of rates as required by the public service commission. There were some equalities on rates but it was claimed that they could not be pointed out specifically because the Bell had no complete rate schedule on file.

Bell and Johnstown Telephone Company schedules will be practically the same throughout this territory, so that no discriminatory charges can be alleged.

The Public Service Commission heard the protest of the Keystone Telephone Company of Philadelphia against the new schedule of rates for service.

It was contended that the proposed rates would not only reduce the revenues of the company to a point below a reasonable profit, but would deprive it of its "flat rate," which constitutes its "slogan." He said the proposed rates would cause the death of the independent lines.

Public service companies, he argued, are entitled under the law to a profit of 6 per cent, and it was the consensus of opinion in the business world that they should have 8 per cent fully to meet the needs of service and stockholders. Under its present rates, he said, the Keystone is earning less than 6 per cent and if the schedule of rates proposed by the commission were to be put into effect this profit would be reduced almost one-sixth.

California

In fixing for the coming year the Board of Public Utilities served notice to the two telephone companies that rates for business telephones will be based upon measured service.

A resolution was passed by the board and copies were sent at once to the Home Telephone Company and the Pacific Telephone and Telegraph Company.

The action of the board was taken when it was learned that the State Railroad Commission had outlined no policy in the matter of fixing telephone rates. A letter of inquiry was sent to the State Commission asking what its policy would be, and the reply which came indicated to the Public Utilities Commission that it had full jurisdiction and could do quite as it pleased in the matter.

The Board of Public Utilities had informed the State Railroad Commission that it did not want to proceed with the fixing of telephone rates if there was to be a change in the method of rate fixing by the State body.

The State Railroad Commission is not in a position to direct any other rate fixing body in the matter, as it has no information concerning measured service upon which to justify such action.

The Los Angeles City Council formally adopted a resolution calling for the submission of the question to the people to decide whether or not they want the council to refuse to authorize more than one telephone system to do business in Los Angeles on and after Nov. 20, 1916, the date of the expiration of the Sunset's franchise.

Illinois

If the Illinois Public Utilities Commission and the federal government give approval the American Telephone & Telegraph Company, holding company of the Bell Telephone Company, will purchase all outstanding securities of the Inter-State Telephone & Telegraph Company. A deal has been practically consummated whereby

the sale is to be made, it has been announced in Chicago.

The negotiations between the Bell Company officers and the bondholders' committee of the InterState Company have been made on the following basis, it is said: The American Telephone & Telegraph Company will buy all the outstanding 5 per cent first mortgage bonds of the Inter-State Company at 46 and accrued interest, all the Inter-State equipment trust notes at 70, and all the Inter-State stock at $4 a share.

A petition has been prepared by the Business Men's Commercial Club of Fairfield and the Wayne County Mutual Telephone Company and filed with the State Public Utilities Commission of Illinois asking that these petitioners should be granted a certificate of necessity and convenience permitting them to install within the city limits of the city of Fairfield another proper and efficient telephone system and equipment; that by the installation of another system these complainants and patrons of the Commercial Telephone & Telegraph Company can be provided with a proper and satisfactory telephone service and accommodations with the rural district in the vicinity of this city.

The public has felt for some time that the present system was very inadequate and the public in general should demand a more efficient service.

It is thought by the Mutual Telephone people and the business men that enough evidence can easily be obtained to prove to the commission the necessity of another telephone system.

Kentucky

An opinion in the case of the Glasgow Home Telephone Company against the Gainsboro Telephone Company and G. T. Tucker was handed down recently by the State Railroad Commission. The Glasgow Telephone Company charged that Tucker, who owns and operates an exchange in Cave City, gave the Gainsboro Telephone Company patrons free service and charged the patrons of the Glasgow Company. The Railroad Commission holds that the act of 1912 gives the Railroad Commission jurisdiction only to compel fiscal connections between telephone exchanges in the same town and to see that there is no discrimination practiced by receiving or failing to give the originating exchange the same service that it gives its own patrons. The commission also holds that it has no jurisdiction to prevent discrimination between competing companies. A demurrer to the petition was sustained to permit the bringing up of the question as to the reasonableness of tolls charged the Glasgow Company by Tucker.

Montana

Better telephone service for the residents of the Shields River Valley, Park county, is foreshadowed in a decision rendered by the Public Utilities Commission, directing the Mountain States Telephone & Telegraph Company to improve the physical condition of certain lines in the valley, and also, within thirty days to file a schedule of rates, non-discriminatory, together with a full explanation of the basis used in compiling them.

The commission holds that the complaint of the Shields Valley Commercial Club, insofar as it has to do with toll rates, is not well founded, and orders that portion dismissed.

The complainants contended the condition of lines out of Clyde Park was such that reasonable service was impossible. In reply the company stated it had decided to construct a new plant at Clyde Park, but the number of subscribers who could be obtained were insufficient to make the plant remunerative.

The commission held that when a public service corporation is serving the public and the rates charged for such service are in and of themselves fair and reasonable for the service rendered, the company must, in exchange, render dependable service; and the fact that a branch line (which is in the nature of a feeder) does not of itself pay, while the main system is enjoying prosperity, is not a good and sufficient reason for non-dependable service.

Michigan

A new complaint has been filed with the Michigan Railroad Commission by the Camden Rural Telephone Company and the Reading Central Telephone Company against the practices of the Bell Telephone Company in refusing the Camden Company independent telephone communication with the city of Hillsdale and elsewhere throughout the state of Michigan over the circuit via Reading, which was the circuit used before the consolidation for all of the independent telephone communication with the Camden Company's several exchanges. The petitions ask that the hearing be held in the city of Hillsdale, that the several companies operating about 4,200 telephones in the county would have an opportunity to be heard at the same time. The complaint cites in detail the manner in which telephone service has been cut off and independent service refused from the several local exchanges of the county. It is set up that under the present mode of operation it is impossible to call a patron of the Jonesville mutual exchange from the city of Hillsdale or from any other place where connection had formerly been made through the Southern Michigan Company. Practically the same is true of the Mosherville exchange.

Kansas

Application for the purchase of the two telephone companies in Ottawa and the building on West Third street owned by the Kansas City Long Distance or Home Company for about $100,000 was made to the Public Utilities Commission of Kansas City this week. The application asks that the utilities board grant permission to the companies to sell to W. P. Hemphill who once withdrew an application for the purchase of the Ottawa system.

It is reported that the utilities board will probably allow the request so that Mr. Hemphill could proceed in the organization of a new company handling the combined exchanges and would be at work on reconstructing the present storm damaged system in two or three weeks.

Ohio

Petitions were filed with the Public Utility Commission of Ohio, signed by hundreds of influential business men and residents of Belmont county and eastern Ohio, praying for relief from the present competitive telephone system now in use in that vicinity. An agreement between the Bell and National lines on the Ohio side so that subscribers of one company may communicate with those of the other company is asked for.

The proposition is nothing new in eastern Ohio as there has been general complaint for years about the necessity of having two telephones in all business houses and offices.

The petitioners are not asking for a consolidation of the rival companies. They are asking that the exchanges

in each city and town be consolidated in order that subscribers for one company may communicate with those of another. Such a system will do away with the expense of carrying two phones when one will serve the same purpose and cover the same territory.

Each company will retain its individuality and will have complete charge of its property and subscribers. Rates, however, will necessarily be uniform and collections will be made as is now in vogue. Expenses connected with the proposed change may be shared equally between the two companies interested.

The petitions of the Home Telephone Company for admittance into Cincinnati over the Bell lines, now pending before the State Public Service Commission, were sustained by that body when the arguments made against them by the Bell and associate companies to have the two petitions made more definite and certain were overruled. The Bell interests asked that the hearing be reopened and they be permitted to re-argue the motion to correct the petitions. The commission granted this request and set March 23 for the re-hearing.

As the result of a petition brought before the Ohio commission, it has been ordered that the Upper Sandusky Telephone Company and the Wharton Telephone Company construct and maintain suitable physical connections between the toll line or station in the village of Wharton, Ohio, of the Upper Sandusky Telephone Company and the exchange of the Wharton Telephone Company in the village of Wharton, Ohio, and by the joint use of the equipment of utilities, establish and maintain a through line of communication between the localities described in said complaint and the subscribers of such utility.

It is further ordered that the joint rate and charges for toll or through service by the Upper Sandusky Telephone Company to the Wharton Telephone Company be furnished and rendered on the same terms and conditions as is furnished by the Upper Sandusky Telephone Company to the Wharton Exchange of the Peoples Telephone Company also operating in the village, as provided in the schedule of rates of said the Upper Sandusky Telephone Company now on file with the commission. It is further ordered that the expense of making such physical connections and the subsequent maintenance thereof be and the same is apportioned equally between the said utilities.

The Lima Telephone and Telegraph Company, Lima, Ohio, has asked for the consent of the commission to issue its common capital stock at the par value to the amount of $32,500 at 6 per cent. Cumulative preferred capital stock of the par value of $32,500, the proceeds to be used to pay the cost, in excess of the sum of $18,500 for the enlargement of petitioner's property, the making of additions and extensions to the switchboard and to the aerial and underground cable and conduit system, and other work connected with the unification of service since the acquisition of the exchange property and telephone building in Lima, Ohio, and certain toll lines and toll circuits in the vicinity of the Central Union Telephone Company. The cost of the work is to be paid with a portion of the proceeds derived from the sale of certain stocks, the issue and disposition of which were consented to and authorized by the Public Utilities Commission of Ohio.

The Ohio State Telephone Company and the Akron Peoples Telephone Company asked the approval of the Ohio commission to grant a purchase by the Ohio State Telephone Company from the Akron Peoples Telephone Company of all its franchises, property, rights, accounts, contracts, privileges and assets to the Ohio State Telephone Company; and further for the consent and approval of the commission to the agreement made between said respective companies.

The commission was satisfied that the public will receive adequate service at reasonable rates, and gave its consent and approval to the agreement of purchase.

The Ohio State Commission has ordered that the Farmers Tri-County Telephone Company of Magnolia, Starke county, Ohio, be authorized to sell, transfer and convey to David H. Forgan, Edgar B. Bloom and Frank F. Doyle, receivers of the Central Union Telephone Company, all of its exchange farmer lines, equipment, apparatus thereunto belonging, serving one hundred and fifteen subscribers, except the exchange farmer lines serving ten of such subscribers, which lines are not owned by the Farmers Tri-County Telephone Company, which lines are connected with the telephone exchange lines of the receivers of the Central Union Telephone Company at the corporation limits of Magnolia and Waynesburg, Ohio, as the same is more fully set out in a detailed statement offered and introduced in evidence as "Exhibit F" on the hearing of this matter, which said "Exhibit F" is hereby made a part of this order by reference; and said David R. Forgan, Edgar S. Bloom and Frank F. Doyle, receivers for the Central Union Telephone Company, are authorized to purchase and acquire said property and to pay therefor the agreed consideration of $3,360.40.

Massachusetts

A thorough investigation of the telephone service and rates in Massachusetts has been recommended by the Public Service Commission in a special report to the legislature. The report follows an order by the legislature several weeks ago asking for certain information regarding the finances of the New England Telephone and Telegraph Company.

Indiana

The Northern Indiana and Southern Michigan Telephone & Telegraph Company filed a petition with the Public Service Commission asking permission to issue $50,000 worth of bonds of which amount the proceeds from $25,000 in bonds are to be used in retiring a bond issue of a like amount and $25,000 are to be used for improvements. The company also filed a complaint against the People's Mutual Telephone Company of Wolcottville contending it had made connections with another company to the detriment of the petitioner and after it had failed to comply with the orders of the commission. The company is located at Lagrange, Ind.

Iowa

The House committee on telephones have agreed to report out for passage a bill which would place the telephones of the state under control of the State Railroad Commission.

The bill proposes to put all telephone business in control of the State Railroad Commission. That board, under it, will have charge of the regulation of rates and of service. Franchises existing which become indeterminate may be terminated by the board, the people voting on new ones thereafter. Present rates remain in force till the board promulgates new ones. All companies are required to make connections with each other when or-

dered by the commission. Competing exchanges cannot be established except by the consent of the board. There now are only nineteen of these in Iowa, whereas three or four years ago there were several hundred.

It was stated by those favoring the legislation that Iowa is one of a half dozen states in which the regulation of the telephone business is purely local, and in forty or more there is state regulation through a general utility commission, the railroad commission, or a special commission.

It also was declared by officers of the independent telephone companies that they unanimously favor the Jones and Francis bills.

The statement was made by officers of the independents that they have discovered anonymous propaganda against the bills, so issued as to deceive the persons to whom it has been sent.

Oregon

Complaining against the rates of the Malheur Home Telephone Company, Salem, Jacob Prinzing, H. C. Boyer and G. L. King have filed a complaint with the State Railroad Commission asking that an investigation be made and that fair and equitable charges for the service be fixed. According to the complaint the Malheur Home Telephone Company bought the Ontario Independent Telephone Company several years ago, and a consideration was that the rates of the patrons for the latter should not be increased. Allegations are made that, in addition to increasing the regular local rates, a long distance charge has been imposed to Nyssa, Ore., and Fruitland, Idaho.

California

Complaints have been made to the commission against the Pacific Telephone and Telegraph Company for charging $5 for taking out telephones and also for demanding that new subscribers sign contracts before the instruments are installed.

The company was requested to file a brief giving facts and figures and the hearing will be taken up again April 15.

The two principal complaints made were answered by the officials, who declared that the cost of removing a phone amounted to approximately $12. They claimed the company attempted to keep the cost of service as low as possible and to distribute it among the subscribers as evenly as they could. By collecting $5 when a phone was taken out a portion of the cost was defrayed, and by requiring a contract at least three months before service was given the company was assured the cost of installation would be partially returned.

Madison Holds Telephone Station Record

In the history of the telephone development at Madison, the capital of Wisconsin, the Wisconsin Telephone Company can claim a record that is unrivaled in the United States. The telephone development of Madison is twenty-eight per cent, which is five per cent higher than that of San Francisco, California, which has been credited with standing at the head in America.

Madison is today a city of 29,469, according to the estimates of the United States Census Bureau. The telephone history of Madison began in 1884. By 1892 the equipment consisted of two switchboard positions, serving ninety subscribers. In 1900 the number of subscribers had increased to 400, and ten years ago, in 1905, Madison's list had reached 525 subscribers. Today there are 8,361 subscribers within the city limits, and 398 rural stations belonging to the exchange, in all 8,759 subscribers.

Interesting Facts About the Transcontinental Run

The New York-San Francisco line is 3,390 miles long.

There are two circuits, each using 6,780 miles of hard-drawn copper wire.

There are 870 pounds of copper wire in each circuit mile, and 2,960 tons in the entire line.

By transposing the two physical circuits there is created an additional circuit known as a "phantom circuit."

If a voice were loud enough to be heard from New York to San Francisco, it would take four hours to travel that distance through the air.

The voice by telephone travels from New York to San Francisco in 1-15th of a second, traveling at the rate of 56,000 miles per second.

The voice of a man speaking in New York is heard in San Francisco three hours earlier, that being the difference in the standard time of the two cities.

The first words were transmitted by telephone March 10, 1876, in Boston. Mr. Watson heard Professor Bell say, "Mr. Watson, please come here; I want you."

The first conversation held by telephone took place October 9, 1876, over a telephone line two miles long between Boston and Cambridge. Mr. Bell and Mr. Watson talked.

The first newspaper report ever transmitted by telephone was sent from Salem, Mass., to the Boston *Globe*.

The New York-San Francisco line crosses thirteen states.

The energy freed by cooling one spoonful of water one degree would operate a telephone for 10,000 years. This baby current of electricity must take a voice 3,400 miles, and it can not be increased, or its power to transmit speech is gone.

One hundred and thirty thousand poles are required to carry the line across the continent.

Four hard-drawn copper wires, .165 inch in diameter, carry the current from ocean to ocean.

In the loading coils for each physical circuit there are 13,600 miles of fine insulated wire 4-1000 of an inch in diameter.

The Panama Canal was begun nine years ago and has cost $310,000,000; within the same space of time the Bell Company has spent twice that amount in its engineering construction work alone.

1914 Rochester Company's Best Year

The Rochester Telephone Company, Rochester, N. Y., states its 1914 earnings were greater than any other year of its history, being three and three-fifths times its bond interest, 24.31 per cent in excess of 1913 after deducting bond interest and 43.12 per cent greater than 1913, after deducting bond interest and depreciation reserve.

It is true the increase may be partly accounted for by the fact that unusual maintenance expense in 1913 was incurred because of severe sleet storms in the early part of the year. Much of the increase, however, may be credited to the excellent present condition of the company's physical property.

Of Interest to the Trade

What the Telephone and Accessory Manufacturers Are Doing to Advance the Art

Loving Cup for Automatic Electric

Automatic Electric Company of Chicago has been presented with a silver loving cup, pictured here. It was presented by the Federal Telephone and Telegraph Company of Buffalo, N. Y., and its employes "in appreciation of services generously given and companionships pleasant to remember," as the inscription states.

A Loving Cup of Appreciation from the Federal Telephone and Telegraph Company of Buffalo to the Automatic Electric Company, Chicago.

The automatic system installed by Automatic Electric Company in Buffalo has been operating six months, and is fulfilling every expectation of the officials and engineers of the Federal Company. The service is proving very popular with the subscribers, and a substantial increase in patronage has been noted since the new system was installed.

Just previous to the date set for the cut over from manual to automatic operation in Buffalo, a fire in the terminal room of the Federal Company's main exchange placed the entire system of 25,000 stations out of service, but with the prompt and effective cooperation of Automatic Electric Company the damage was repaired, and the cut over completed in ten days, a record for magnitude and speed probably unsurpassed in telephone work.

Kellogg at Des Moines Convention

Great interest has been manifested in the instantaneous recall switchboard, designed and first installed by the Kellogg Switchboard & Supply Company, at the many conventions where it has been shown, and the Iowa Independent Telephone Association meeting held at Des Moines, March 9, 10 and 11, proved no exception.

Two hundred really interested telephone men were shown its operation during the three days' session. There are now a dozen exchanges operating the Kellogg instantaneous recall switchboard with greatly improved service and increased economy.

Much favorable comment was made on the general completeness of the Kellogg exhibit, its apparatus display panels containing over seven hundred parts. All types of telephones were also shown on special display boards.

The exhibit was in charge of W. R. Hind and W. S. Bose. Other representatives were A. J. Carter, general sales manager; H. N. Faris, Kansas City manager, and wife, and O. F. Cassaday, sales engineer.

Mesdames Faris, Hind and Bose were interested visitors during the meetings.

To Spend $200,000 on Muskegon System

Two hundred thousand dollars are to be spent at Muskegon, Michigan, during the next six months by the United Home Telephone Company in completely rehabilitating its telephone system in that city.

According to Thomas Bromley, Jr., treasurer of the company, and general manager since 1906, the plans call for the erection of a new building, the rebuilding and extension of the outside construction and the installation of complete new central offices and subscribers' equipment of the full automatic type. It is expected that the entire undertaking will be completed by September, 1915, and that the United Home Company will then have one of the most complete and modern telephone systems in the world.

The new building, designed especially for the company, is to be a two-story and basement structure, 40 by 70 feet. The walls will be vitrified brick and terra cotta, and the construction of the steel and concrete type. It will accommodate the general offices of the company, with a special room for the directors, and will house the central office and long distance equipment. Ample storage space for supplies and material will be provided in the basement.

The outside construction will be entirely of cable, the portion lying in the business section of the city being underground. The wire plant will provide facilities for 4,500 subscribers, but is so designed that the system can be converted to the multi-office type when future growth demands such a move.

The central office equipment will provide immediate facilities for 2,000 lines and 3,000 telephones. A four-position toll, rural and pay station board, and a two-position combination wire chief and information desk, are also to be installed. The entire apparatus will be manufactured and installed by Automatic Electric Company of Chicago.

In addition to this work in Muskegon, the company will arrange a large portion of its 700 miles of toll lines for automatic operation. This, it is believed, will greatly increase the speed of service, enhance the efficiency of the toll lines and reduce the number of operators, for all long distance calls to Muskegon, Pentwater and Grand Rapids will be set up by the operators in the originating office instead of being completed in the receiving office.

The United Home Telephone Company was organized in Ludington, Michigan, in 1906. The properties of the Lake Shore Telephone Company were acquired and substantially extended and improved. In 1913 the Citizens' Telephone Company plant in Muskegon was absorbed and the entire system of nearly 5,500 telephones was consolidated.

Soon after acquiring control at Muskegon, the com-

pany, following its usual policy, began to consider plans for the system there. Mr. Bromley, together with the other officials and directors, made a careful investigation of all types of equipment on the market. They visited exchanges operating all the various systems and studied their operation. As a result they decided that full automatic offered the greatest advantages under the conditions in Muskegon, and that apparatus was consequently adopted.

The financial condition of the United Home Company is excellent. Of the stock, $300,000 of preferred and $116,000 of common are outstanding, representing a capitalization of less than $90 per station. Dividends have been paid regularly since the organization of the company, while a 6 per cent annual depreciation fund has been set aside. The Muskegon improvements and extensions are being financed by a bond issue recently authorized by the Michigan Railroad Commission. These bonds have been purchased by the Grand Rapids Trust Company of Grand Rapids, Mich.

The officers of the United Home Telephone Company are: J. K. Flood of Hart, Mich., president; G. T. Sands of Pentwater and William Rath of Ludington, vice-presidents; Thomas Bromley, Jr., of Muskegon, treasurer and general manager; and J. H. Moore of Muskegon, secretary. The board of directors includes J. K. Flood, W. R. Roach and H. S. Newton of Hart; Thomas Bromley, Jr., J. H. Moore, Thomas Hume, H. G. Emery, Jr., W. H. Mann and William Monroe of Muskegon; William Rath and W. A. Cartier of Ludington; G. T. Sands of Pentwater; G. L. Churchill of Shelby; J. B. Conger of New Era, and C. E. Tarte of Grand Rapids.

Besides its system at Muskegon, the company operates exchanges in Ludington, Pentwater, Hart, Shelby, Coopersville, Crystal Valley, Fountain, Freemont, Fruitport, Hesperia, Montague, Scottsville, Walkersville and White Hall.

Klein Brings Out New Pliers

Mathias Klein & Sons, manufacturers of linemen's, electricians,' and construction tools, Chicago, have placed on the market two new designs in "millinery" pliers.

These new Klein products have been created to meet a widespread demand for pliers which will effect a clean cut without breaking silk-covered wire

Klein's New Pliers.

and with safeguards against the possibility of the wire becoming caught in the joint. This desirable essential is accomplished by means of lap joint construction as opposed to the box joint pliers.

These new pliers are made of the same quality of tool steel, hand forged, which characterizes all Klein pliers.

Belden's Catalogue No. 6

The Belden Manufacturing Company, Chicago, has issued its catalogue No. 6 of electrical wires, cables and cordage. More than thirty new pages have been added to the last edition, in order to list the following items:

Magnet wire, square and rectangular forms; enameled and asbestos covered magnet wire, Chromel resistance wire, Deltatape, phosphor bronze wire, moving picture machine cable, motor lead or brush wire, new styles of automobile ignition and lighting cable, flexible metal conduit, armored cable, Belden-Bakelite molded insulation and parts, Bakelite sheets, rods and tubing, wireless telegraph wire, "Litzendrath" wire, miscellaneous flexible cordage, new tips and terminals, new stranded copper cables, winding machines, tension device, varnishes, tapes and webbings.

Belden Catalogue No. 6 has been planned along the same lines as its predecessor, containing detailed prices, specific information about Belden products, besides useful wire tables and data. In addition to a few necessary corrections, the company has endeavored to arrange lists so that price figuring will be simple and easily understood.

Eight Messages Over One Wire

The Western Electric Company has just placed on the market a printing telegraph system. By this system, a message, written upon a modified form of typewriter at one end of a telegraph line, is automatically printed, ready for delivery, at the other. Furthermore, not only one, but *eight* messages may be sent simultaneously over a single wire, each message being printed as fast as the sending operator can typewrite it. A trial installation of this system, made by the Western Union Company, has been operating between New York and Boston for the past year and a half, and has been working practically day and night, frequently at a total speed of 360 words a minute.

So widely is the Western Electric Company of today known as a manufacturer of telephone apparatus that we are likely to lose sight of the fact that the company first came into prominence, not in connection with the telephone, but as a maker of telegraph instruments. The firm of Gray and Barton, founded in 1869, and incorporated in 1872, as the Western Electric Manufacturing Company, derived its principal revenue from the manufacture of Morse telegraph instruments and telegraph printers. The invention of the telephone, in 1876, opened a new field for the activities of what has since become the Western Electric Company; but the company continued to manufacture telegraph apparatus on an extensive scale, and still does so.

The history of the printing telegraph dates back about sixty years. Although the art is old, and has always been a field particularly attractive to inventors, printing telegraphs, for one reason or another, have not come heretofore into extensive use in this country. The new system, however, promises to popularize the method of intelligence transmission in many commercial fields.

A six-volt electric vulcanizer for automobile tires, operable from the car's own battery, is the latest product of the Premier Electric Company, Chicago.

Brevities of the Business

The Activities of the Whole Telephone Field Told in Short Paragraphs

PERSONALS.

On March 3 Dr. Alexander Graham Bell, the inventor of the telephone, celebrated the 68th anniversary of his birth.

F. L. Barber of Aurora, vice-president of the Interstate Telephone & Telegraph Company, was recently elected chairman of the executive committee of the Independent Telephone Association at the convention recently held at Spuringfield, Illinois.

V. W. Deist of Madison, Wis., has been appointed local manager for the Wisconsin Telephone Company at Baraboo, succeeding Oscar Quale.

Richard T. M'Comas was elected vice-president of the Cincinnati and Suburban Bell Telephone Company at Cincinnati, Ohio.

Oscar Quale has assumed the position of manager of the Reedsburg Telephone Company, Reedsburg, Wis., succeeding E. G. Stolte.

Robert Windsor has resigned as a director of the American Telephone & Telegraph Company of New York, N. Y.

T. H. Crosby, formerly of Portland, Ore., has been elected president of the Winlock Home Telephone Company of Centralia, Washington.

W. M. Cox of Harriman, Tennessee, has been appointed manager of the Cumberland Telephone Exchange at Bristol, succeeding E. H. Moorer, who goes to Harriman to take charge of the Harriman exchange.

R. E. Manley has been appointed engineer of the Ohio Division of the Central Union Telephone Company at Columbus, Ohio, succeeding A. J. Walker, who has been promoted to a position on the staff of the chief engineer of the company at Chicago.

K. J. Dunstan, formerly manager of the Toronto exchange of the Bell Telephone Company, has been appointed manager of the Ontario division, with headquarters at Toronto. Frank Kennedy has been appointed to fill the vacancy left by Mr. Dunstan.

W. G. Seath, chief clerk to district manager Porter of the Missouri & Kansas Telephone Company at Springfield, Mo., has been promoted to local manager.

R. F. Jones of the Bell Telephone Company in Montreal, has been promoted to division manager of the Eastern Division, with headquarters at Montreal.

C. F. Sise, who for thirty-five years has been president of the Bell Telephone Company of Canada at Montreal, has resigned his position, and is succeeded by L. B. McFarlane, formerly managing director of the company.

James T. Daniels has been promoted from manager of the collection and accounting departments of the Central Union Telephone Company in Columbus, Ohio, to state traffic superintendent of the company, succeeding the late F. W. Whitten.

B. J. Throop, former manager of the Bell Telephone Company in Hamilton, Ont., Canada, died February 24. Mr. Throop became interested in the telephone industry in 1881, and two years ago, failing in health, he was compelled to resign from active service.

J. C. Vaughn has been elected president of the Entiat Telephone & Telegraph Company at Washington.

C. H. Webb of Washington, Ind., representing New York and Chicago interests, was recently elected president and general manager of the Hudson & Middlesex Telephone & Telegraph Company at Perth Amboy, New Jersey.

Charles B. Gillespie died at his home in Weymouth Landing, February 25. He was connected with the advertising department of the New England Telephone & Telegraph Company's office at Boston, Mass.

NEWS FROM THE FIELD.

ALABAMA.

The Southern Bell Telephone Company's Exchange at Montevallo was recently destroyed by fire. The damage is estimated at $5,000.

CALIFORNIA.

The Ehman Olive Company of Olinda has closed a contract with a local electric company to construct eight miles of telephone line, conecting its offices at Olinda, in Happy Valley, with Anderson. The line will require 230 poles and eighteen miles of copper wire, the work of erection to begin at once.

The Tehama County Telephone Company of Red Bluff has authorized its president and secretary to sell the entire holdings of the company to the Sacramento Valley Telephone Company for the sum of $57,000. The sale will be made subject to the approval of the railroad commission.

The new company will also take over the local business of the Bell System in this county.

Twenty persons in Orange Cove route between Orange Cove and Dinuba have associated themselves into a company to be known as the Orange Cove Mutual Telephone Association and will build a telephone line connecting with the central station in Dinuba.

Ninety days' additional time has been granted the Home Telephone Company of Santa Barbara to place its wires underground on Fourth street from E to Arrowhead by the city council.

CALIFORNIA.

The state railroad commission has issued an order extending to April 30, 1915, the time within which the Butte Valley Telephone Company of Siskiyou county may issue twenty-two shares of stock at the par value of $10 per share.

State Railroad Commissioner Alex Gordon of Sacramento has issued an order permitting the Pacific Telephone and Telegraph Company to take over the Weed Lumber Company's telephone system and to purchase certain properties for the installation of a complete telephone system and plant.

C. M. Kirby of San Francisco, owner of telephone property at Dixon, Solano county, has filed an application with the railroad commission requesting authority to transfer his interest therein to the Pacific Telephone and Telegraph Company for the sum of $500.

CANADA.

At the annual meting of the Bell Telephone Company of Canada held at Montreal, February 25, the following officers were elected: C. F. Sise, chairman; L. B. McFarlane, president; Hon. Robert Mackay, vice-president; Theo. N. Vail, Robert Archer, Hugh Paton, Charles Cassils, Z. A. Lash, K. C., U. N. Bethell, C. F. Sise, Jr., Andrew J. Dawes and Thomas Ahearn.

A telephone line from Waneta to Nelson B. C., and through to Trail has been completed.

The Brouse Telephone Company are issuing new stock with which to provide extensions and also to acquire the Nakusp town telephone system.

COLORADO.

The Mountain States Telephone & Telegraph Company, Grand Junction, has submitted to the city commissioners a proposition to pay the city 2 per cent of the annual gross earnings of the local plant, in return for the use of the streets and alleys of the city. The matter will be taken up later.

CONNECTICUT.

Within the next three months the Marquis Telephone System and the New York Telephone Company of Norwich will combine their local telephones on one switchboard and will operate under the Bell, if the Attorney-General of the United States and the Public Service Commission agree to the proposition.

FLORIDA.

The demonstration equipment of the Automatic Telephone Company, which was recently granted a franchise to operate its system in Key West, has been shipped to that city from Chicago, and will be placed in operation shortly.

On or about April 1 the Peninsular Telephone Company, Tampa, will make the change from the manual to the automatic system.

GEORGIA.

The annual meeting of the stockholders of the Quitman Telephone Company was held at Quitman on March 15, and the following officers were elected for the coming year: S. S. Rountree, president; W. A. Walker, vice-president, and W. R. Hunter, secretary-treasurer and general manager.

The McRae-Helena Telephone Company, McRae, has been incorporated with a capital of $20,000 by J. F. Cook and others, to construct a telephone system.